FEDERAL PUBLICATION

PUBLIC DOCUMENTS
DEPOSITORY ITEM
DEC 15 1994
CLEMSON
LIBRARY

Hurricane Andrew, 1992

The National Park Service Response in South Florida



BIG CYPRESS NATIONAL PRESERVE
BISCAYNE NATIONAL PARK
EVERGLADES NATIONAL PARK

United States Department of the Interior / National Park Service

Copies of this report are available from the following:

Hurricane Andrew Incident Management Team
National Park Service
c/o Natural Resources Publication Office
P.O. Box 25287 (WASO-NRPO)
Denver, CO 80225-0287

This report is an objective account that describes the historical event and the impact of Hurricane Andrew on the three national parks in south Florida. The report emphasizes the preparation that park staffs took before the hurricane, its occurrence, and the response of the National Park Service after the hurricane. This report is not a review of actions and does not examine or judge management activities of the National Park Service. The information that was available made it feasible only to provide an overview, with greater detail where possible.

Printed on recycled paper



Hurricane Andrew, 1992

The National Park Service Response in South Florida

BIG CYPRESS NATIONAL PRESERVE
BISCAYNE NATIONAL PARK
EVERGLADES NATIONAL PARK

August 1994

United States Department of the Interior / National Park Service



Digitized by the Internet Archive
in 2012 with funding from
LYRASIS Members and Sloan Foundation

http://archive.org/details/hurricaneandrew100nati



Preparers

Incident History Group

Cordell J. Roy, Group Leader
Superintendent, Timpanogos Cave National Monument

Donna O'Leary, Editor
Publications Coordinator, Natural Resources Publication Office
Office of the Associate Director, Natural Resources

Kathy Billings, Management Assistant
Joshua Tree National Monument

Pat Buccello, Special Agent
Rocky Mountain Regional Office

Sharon Clark, Fire Program Assistant
Saguaro National Monument

Kathy Davis, Natural Resource Specialist
Southern Arizona Group Office

Mark Hardgrove, Assistant Superintendent
San Juan Island National Historical Park

Paul McLaughlin, Resource Management Specialist
Division of Natural Resources
Alaska Regional Office

Jim Northup, Chief Park Ranger
Big Bend National Park

Jon Paynter, Natural Resource Specialist
Office of the Associate Director, Natural Resources

John Sacklin, Chief, Planning and Compliance
Yellowstone National Park

A number of individuals assisted the incident history group with information for the report and with the report's final production. The resource assessment task force led by Gary Davis, Channel Islands National Park, and the facility assessment task force led by Cliff Blackstun, Denver Service Center, provided the information for those sections. Connie Toops contributed photographs of Everglades National Park and nearby communities. Linda Ray, Judy Dersch, and Joan Huff, Denver Service Center, provided graphic services.



Contents

FOREWORD ix

SUMMARY xi

The Introduction

ORIGIN AND PURPOSE 3

SCOPE AND CONTENT 5

SOUTH FLORIDA NATIONAL PARKS 7

- Big Cypress National Preserve 7
- Biscayne National Park 9
- Everglades National Park 10

The Chronology of Hurricane Andrew

The National Park Service Response

HURRICANE PREPAREDNESS PLANNING 37

- Management Direction 37
- Hurricane Planning in South Florida 37
- Hurricane Plans of South Florida National Parks 38
- Hurricane Preparedness Condition Levels 38

PATH OF HURRICANE ANDREW 39

- Origin of Hurricanes 39
- Regional Hurricane Phenomena 40
- Hurricane Andrew 40

INCIDENT COMMAND SYSTEM 45
Incident Management Team 45
Incident Command System and Hurricane Andrew 47
Incident Command Functions 52
Information 52
Safety 55
Training 55
Logistics 56

INCIDENT MANAGEMENT CHALLENGES AND INNOVATIONS 59
Human vs. Hurricane Andrew 60
Employee Assistance Programs 64
Employee Assistance Teams 64
Critical Incident Stress Debriefing Program 67
Other Programs 68
Emergency Medical Program 69
Housing 71
Power 73
Powerline to Flamingo 74
Communications 74
Logistics 75
Interim Hurricane Plan 76
Technical Specialist, Hurricane 77
Facility and Resource Assessment Task Forces 77
Hazardous Material Removal 78
Video and Other Documentation 78
Transition Plan 79

FACILITY ASSESSMENTS AND MAINTENANCE ACTIVITIES 81
Buildings and Visitor Facilities 85
Government-Owned Housing 87
Electrical Systems 89
Water Systems 90
Sewage Treatment Plants and Septic Systems 92
Radio Systems 92
Telecommunications 93
Roads 94
Campgrounds 95
Boardwalks and Trails 96
Backcountry Facilities 97
Trees and Landscaping Materials 97
Signs and Navigational Aids 98

Docks and Piers 99
Dams and Water Control Devices 99
Hazardous Materials 99
Park Files 100
Vehicles and Equipment 101
Supplies and Materials 102

RESOURCE ASSESSMENTS 103
Vegetation 104
Fuels and Fire Management 107
Exotic Plants 108
Wildlife 109
Air and Water Resources 109
Marine Ecology 112
Freshwater Resources 114
Cultural Resources 116

GLOSSARY 117

Figures

1. South Florida Region 8
2. The Track of Hurricane Andrew 41
3. The Track of Hurricane Andrew through South Florida 43
4. Incident Command Organizational Chart 49
5. Branch Boundaries for Hurricane Andrew Incident 50
6. Number of Personnel on the Hurricane Andrew Incident 52

Tables

1. Saffir/Simpson Hurricane Scale 40
2. Big Cypress National Preserve Damage Assessment 84
3. Biscayne National Park Damage Assessment 84
4. Everglades National Park Damage Assessment 84
5. Effects of Hurricane Andrew on Selected Wildlife Species 110



Foreword

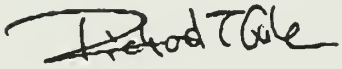
This report describes the response of the National Park Service in the recovery efforts in the aftermath of Hurricane Andrew at the three south Florida parks—Big Cypress National Preserve, Biscayne National Park, and Everglades National Park. While this narrative effectively details the preparation and the recovery efforts that were taken to mitigate the storm damage, this report does not and cannot fully describe the human emotions that were involved in confronting the devastation of the hurricane, whether those emotions of the victims or those of the responders—and all too often, people were both simultaneously.

As realization grew that a hurricane of horrible proportions was headed towards south Florida, staff from the three parks worked long, hard hours to protect human life and property. These employees went through six horrifying hours of wind gusts over 160 mph. Some were in their homes when portions of their houses blew away, allowing the hurricane to enter what had been their shelter and refuge. The scope of the destruction to their homes, communities, and parks was overwhelming. Throughout the Hurricane Andrew incident and recovery, but especially during the first week, these park employees performed selfless, and, at times, heroic acts in aiding fellow employees and surrounding community neighbors.

The welfare of the employees of the National Park Service and their families was of primary concern in all aspects of the Hurricane Andrew recovery effort. Numerous local agencies and organizations provided immediate and effective assistance. Incident personnel from over one-fourth of the other parks in the National Park System, other federal agencies, and organizations contributed tirelessly and under extremely difficult working conditions to the recovery efforts. To list all those who helped, regardless of agency, or whether on-scene or filling in back home for employees sent to south Florida, would require an appendix almost as large as this report. Getting enough help was never an issue.

Facilities will be repaired or rebuilt. The wonderful ecosystem that is the everglades will recover. What is much harder to fix are the victims—making people whole again. Broken facilities are easy, broken lives more difficult.

As you read this report, then, do so within the context that the recovery effort in south Florida is the best effort the National Park Service has ever accomplished in the people business.



Rick Gale,
National Park Service
Incident Commander
Hurricane Andrew Recovery



Summary

In late August 1992, Hurricane Andrew grew from a tropical disturbance to one of the strongest hurricanes to hit the mainland United States. Early in the morning of August 24, the hurricane made landfall directly over the Convoy Point visitor center in Biscayne National Park. With sustained winds of 145 mph and gusts of over 160 mph, Hurricane Andrew tore into the heavily populated communities of Cutler Ridge, Florida City, and Homestead. The hurricane continued west across the headquarters area and the central portion of Everglades National Park and the southern portion of Big Cypress National Preserve. Four hours after landfall, Hurricane Andrew departed from the west coast of Everglades National Park. The swath of wind damage was approximately 30 miles wide across south Florida.

At the beginning of the hurricane season in June, park staff at Big Cypress National Preserve, Biscayne National Park, and Everglades National Park had been instructed on how to prepare for a hurricane, in accordance with each park's hurricane plan. Preparations included monitoring weather broadcasts, tracking tropical storms, stocking hurricane shelters, and outlining each person's responsibilities at work and at home.

Staff at Everglades National Park started tracking tropical storm Andrew on August 18. Five days later, on August 22, a hurricane watch was issued for south Florida: *hurricane may threaten area within 36-48 hours*. The three parks (and Fort Jefferson National Monument which was not affected by the hurricane) implemented emergency operations. These operations were centralized under the Incident Command System, and a park incident commander was designated to direct the operations.

Public facilities were closed, and visitors, concessioners, and inholders were assisted in evacuating the parks. Buildings and equipment were secured.

At 0600 on August 23, a hurricane warning was issued for south Florida: *specific area has been targeted as possible landfall location; hurricane-force winds are expected within 24 hours.* Preparations of park facilities were terminated, and employees were released to evacuate to safe locations.

Flamingo, Key Largo, and East Everglades staff, three employees from Biscayne National Park, and Everglades staff who lived in park housing evacuated to Pine Island in Everglades National Park. Everglades City and Gulf Coast employees evacuated to the Oasis visitor center in Big Cypress National Preserve. Other employees from the three parks evacuated to their homes in the Florida City/Homestead area or to other communities north of the parks. Fort Jefferson residents remained at the fort.

Employees at the Everglades shelters, watching the storm, observed huge trees flying by, parallel to the ground. Storm shutters were ripped off, sheets of water flowed through the tops and bottoms of doors and, in some offices, the ceilings collapsed. Elsewhere, a recurring story emerged of employees riding out the storm with family and friends, running in fear from room to room, glass shattering, roofs ripping open, and finally huddling together with loved ones, strangers, and pets in closets, kitchen cabinets, or under furniture.

At daybreak on August 24, after the storm had passed, park staff at Everglades National Park ventured out from their shelters to assess the damages. Park facilities and residences had received major damage—roofs had been ripped off or were leaking, windows were broken, and flooding was reported. Roads were impassable due to downed trees and branches, powerlines, and debris. There was no electricity, no phones, limited radio communications, no water, and no sewer.

The task of accounting for all employees from the three parks, securing the parks, assessing the damages, stabilizing the structures, and even beginning the rebuilding process was clearly beyond the capability of the park incident management team. The team, calling out on a cellular phone from Everglades, contacted the Washington Office and the Southeast Regional Office, explained the destruction and the devastation from the hurricane, and requested that the National Park Service (NPS), Type I Incident Management Team, a special events team, and a skilled maintenance team be sent as soon as possible.

The August 25 operations plan for Everglades National Park identified the incident objectives for the first day after the hurricane: secure Flamingo, open roads to the Daniel Beard center and Flamingo, keep water on-line, schedule for gas and electricity at Pine Island, evaluate the fuel situation, and begin assessing and documenting the damages. The number one priority for the incident that day was safety; safety would remain a high priority throughout the recovery period. Most primary incident

command positions were filled, and all available park employees were assigned responsibilities within the park incident management team.

A dispatch office and a supply depot were established at the Oasis visitor center in Big Cypress National Preserve. Supplies, food, and generators were ordered and brought in through Fort Myers and Naples. Big Cypress staff began transporting supplies to Everglades on August 25. One-way trips to Pine Island took 4-5 hours, with flat tires being common due to nails and debris on the roads.

The special events team arrived the morning of August 26 and were assigned to security checkpoints, saw teams, and salvage teams for supplies and emergency equipment. The Type I Incident Management Team, arrived at Everglades 30 minutes later. At 1100 that morning, the superintendents of Big Cypress National Preserve, Biscayne National Park, and Everglades National Park signed a delegation of authority to the incident commander of the Type I Incident Management Team. Existing staff from the three parks continued to fill a number of incident positions, but additional incident personnel were ordered and started arriving within days of the storm.

The Type I Incident Management Team immediately began organizing and planning for managing the recovery efforts of the three parks. Overall objectives for the incident and recovery were established, and all incident command functions (information, safety, planning, finance, operations, and logistics) focused on these objectives.

Hurricane Andrew Incident and Recovery Objectives

1. Provide for basic emergency needs of employees and families of Big Cypress, Biscayne, and Everglades.

2. Provide for employee safety.

3. Prevent further damage to resources, property, and facilities.

4. Secure, protect, and salvage all facilities.

5. Rehabilitate facilities to permit normal use.

6. Assess the restoration and rebuilding needs for structures and facilities, including the requirements for supplies, materials, and equipment.

7. Prepare a factual account of the Hurricane Andrew incident as it pertains to the parks in south Florida from documents and interviews.

Because of the immense geographical area that needed to be managed, three branches were created. Groups within each branch handled various tasks; each branch had a security group and a group that was responsible for cleanup and repairs to facilities. A separate air operations branch managed helicopter and fixed-wing aircraft.

Technical specialists were recruited to handle specific functions. The superintendent of Fort Sumter National Monument, South Carolina, had experience Hurricane Hugo and was brought in as deputy incident commander for contingency planning. His understanding of how things worked and how people reacted after a hurricane provided valuable insight to the Incident Management Team. A resource specialist advised the team on natural resource management issues. A photo specialist documented the storm's aftermath.

The Incident Management Team also recognized that the Hurricane Andrew incident and recovery would provide incident trainees from many agencies an opportunity to receive on-the-job training. A training unit was established.

The Incident Management Team faced numerous challenges. Most roads were inaccessible due to downed trees, powerlines, and debris. Lack of power was a critical problem. Overhead lines were downed throughout south Dade County. Communications with the outside world were limited. The nearby communities were in chaos; the team could not rely on any local infrastructure. Housing was also a serious challenge. Adequate lodging and food services were needed for displaced employees and their families and incident personnel.

The welfare of park employees and their families was of primary concern to the National Park Service. Each employee from the three parks needed to be contacted and their situation evaluated, including those that had evacuated to their homes in the Florida City/Homestead area or to other communities farther north. In the short-term, some would need survival supplies (drinking water, ice, food, and roofing and covering materials) as soon as possible. In the long-term, some would require more assistance, such as temporary housing or repairs to their residences.

Within 24 hours after the storm, employee assistance teams were established. These teams were made up of two or three park employees, with at least one law enforcement ranger. Within 36 hours, these teams went into the communities to distribute survival supplies to park employees and their families. Because of the devastation in the communities, the teams feared that they would discover fatalities or serious injuries. Travel was hazardous, frustrating, and extremely time-consuming. Normal landmarks had been destroyed. The teams faced traffic problems, damaged vehicles using the roads, downed powerlines, law enforcement situations, strong thunderstorms, rescuer-victim conflicts, people in shock, and health risks.

The governor of Florida declared martial law, and a curfew was set in south Dade County.

All NPS employees were finally accounted for by August 30. Over 600 contacts were made with park employees and their families. In addition to contacting NPS employees, the teams also contacted contract researchers, volunteers-in-parks (VIPs), natural history association employees, concessioners, and NPS retirees in the area.

Of approximately 210 NPS employees working in the three national parks, 101 lost their homes and another 76 had major property damage. People were in shock, overwhelmed by their losses, afraid of financial ruin and homelessness, concerned about family members, afraid for their safety because of looting and other criminal activity, and depressed over the amount of destruction to their homes, communities, and the parks. In the early days of the incident, the rescuers were also the victims of Hurricane Andrew.

After providing survival materials to employees, the top priority was to ensure that park employees had adequate shelter, that their property was taken care of, and that their belongings were secured. The employee assistance teams moved the personal property of employees to park storage, stabilized employee homes, and delivered generators, plywood, tar paper, nails, and plastic sheeting to employee residences.

For those whose homes had received severe damage, temporary shelter was provided at several locations, including undamaged park housing in Big Cypress National Preserve. The Flamingo lodge in Everglades National Park had not been damaged, but this facility did not have any utilities. Power was supplied with generators, and the sewage treatment plant was brought back on-line. Within two weeks after the storm, the Incident Management Team was able to provide housing for displaced park families and incident personnel. A rental agreement was later developed to rent 30 houses for displaced employees, mostly in the Key Largo area, under a one-year lease.

Other employee assistance programs were initiated, such as providing monetary assistance to park employees from a donation account, granting administrative leave due to personal emergencies, establishing an 800 number (employee hot line), and providing information on relocation assistance and free legal advice.

Recognizing that the destruction of Hurricane Andrew could cause severe emotional stress to the victims and the rescuers, the Incident Management Team activated the critical incident stress debriefing (CISD) team within 72 hours after the storm. The CISD team, with NPS peer supporters and mental health professionals, provided emotional support, counseling, and stress education. Although the CISD concept has been used in emergency services for at least 15 years, this incident was the first time that the National Park Service used this technique for a long-term disaster response.

In addition, a two-year stress management contract was negotiated to provide on-site services for employees and their families.

Park medics, a specific certification level recognized only in the National Park Service, established medical units in Big Cypress National Preserve, in Biscayne National Park, and at the Pine Island and Flamingo areas in Everglades National Park. During the first four weeks, these units treated over 300 employees and incident patients and inoculated 200 people for tetanus and hepatitis. They also obtained prescription medications for employees that were displaced or personnel involved in the incident.

Because the limited generator capacity of the parks was not sufficient to support the type of resources that were needed to manage the incident, generators were ordered. By early September, generators capable of producing a total of 2.2 megawatts of power had been acquired and were operational throughout the parks.

Rather than replace the downed powerline to Flamingo in Everglades, the decision was made to place that section of powerline underground. Design and contracting experts were brought in to expedite the project. A construction account was assigned, and $6.5 million was authorized for the work. The contract was completed in 108 working hours and construction began October 1. Commercial power was restored in early December.

Telephone lines were down in Biscayne and Everglades National Parks. Cellular telephone systems were not reliable due to the volume of competing traffic. Radios worked, but they were not reliable. A variety of actions were taken in the early days following the storm to establish communications with the outside world. Later on, telephone capabilities were expanded through the use of a satellite system; this incident was the first use of this type of system by a land management agency.

A maintenance task force, made up of highly skilled NPS craftsmen who had the distinct advantage of knowing NPS construction standards and practices, was assigned to restore and rehabilitate park facilities. Fire crews and interagency hotshot crews were used in clearing and cleanup operations. These crews worked under difficult conditions, with high temperatures and humidity and poisonous plants, insects, and snakes.

In addition to stabilizing, salvaging, and rehabilitating park facilities, the Incident Management Team addressed the issues of hazardous materials, the fire management operations of the parks, and the potential for another hurricane. The Type I team also recognized the need to assess the damages to the facilities and the effects of the hurricane on the resources.

Surveys were conducted for contaminants, and a contract was established to remove hazardous materials from the three parks.

The Incident Management Team worked to restore fire initial attack capabilities and the fire management operations. The team managed the fire program for the parks until September 18.

The Type I team developed an interim hurricane plan for the parks that was approved on September 27. The plan addressed the problems of preparing for a new hurricane, with the potential of having incident personnel on-scene, in addition to park staff who had experienced Hurricane Andrew.

A facility assessment task force, consisting of engineers and architects from the National Park Service, Denver Service Center, assessed all park facilities and developed cost estimates. As expected, damage was most severe in parts of Biscayne National Park and Everglades National Park. Flamingo, in the southern portion of Everglades, and Big Cypress National Preserve, were damaged, but to a much lesser extent. Preliminary facility damages to the south Florida national parks were estimated at $1.2 million for Big Cypress National Preserve, $13.6 million for Biscayne National Park, and $17.5 million for Everglades National Park.

A task force of scientists and technical specialists from agencies, universities, private firms, and the National Park Service assessed the effects of the hurricane on the natural and cultural resources of the three parks.

- Virtually every tree in hardwood forests sustained major damage. Pine stands in the path of the hurricane lost 25-40% of the trees. Hurricane Andrew knocked down 70,000 acres of mangrove forests in the parks.
- No immediately obvious effects were observed on wildlife, and little direct mortality was noted.
- Andrew generated more than 40 million cubic yards of storm debris, and that debris may adversely affect the air and water quality of the parks.
- Damage to upland archeological sites appeared to be relatively light, and damage to submerged cultural resources was much less than expected.
- Marine environments fared well in comparison with terrestrial systems; however, sponges in Biscayne Bay were heavily impacted. Water quality and freshwater fish appeared normal.

By October 10, 1992, 593 individuals from 98 national parks, 16 national forests, and several other organizations had been assigned throughout the incident. By October 24, total expenditures for the incident were $6,795,972.

Formal return of the delegation authority was made to the park superintendents on October 24, 1992. However, park staffs resuming the management of the parks was only one step in a long transition back to near-normalcy for the three parks. Recovery of the staff, facilities, and resources will be a long, slow process, and, in some instances, full return to prehurricane conditions may not be achieved.



The Introduction



Origin and Purpose

The National Park Service, Type I Incident Management Team, supervising the recovery efforts following the passage of Hurricane Andrew, recognized the need to document the events of the storm, the effects of the hurricane on the national parks in south Florida, and the National Park Service response to the incident. On September 13, 1992, a special task group met with the Type I incident commander to initiate this report; this group became known as the incident history group.

The objective for this group was to prepare a factual account of the Hurricane Andrew incident and the recovery of the national parks in south Florida. The Type I Incident Management Team prepared much of the documentation that was used for this report. Additional information came from reports, publications, plans, documents, and personal interviews and communications. The reference materials are on file at the parks. Most of the research and writing of this report was accomplished from September 13 to October 6, 1992, with reviews and editing occurring throughout 1993.



Scope and Content

This report emphasizes the period from August 18 to October 24, 1992, from preparing for the hurricane to the transition of the recovery efforts back to the parks. The report is divided into three major parts.

The Introduction describes the scope and content of this report and introduces Big Cypress National Preserve, Biscayne National Park, and Everglades National Park—the three parks in south Florida that Hurricane Andrew affected.

The Chronology of Hurricane Andrew presents the sequence of some of the activities that the National Park Service took before, during, and after the hurricane.

The National Park Service Response describes in more detail, through several of the following major sections, the Hurricane Andrew incident and the recovery efforts of the National Park Service.

The policy and the hurricane planning that directed the activities of the three parks in preparing for Hurricane Andrew are discussed in the Hurricane Preparedness Planning section.

The Path of Hurricane Andrew section follows the storm from a meteorological perspective that includes how hurricanes originate and the hurricane phenomena as it relates to south Florida. This section also tracks Hurricane Andrew, from August 14 when Andrew was a tropical disturbance to August 28 when the remnants of the storm joined a frontal system over the mid-Atlantic states.

The Incident Command System (ICS) concept is discussed. The ICS structure has been in place for a number of years. Although the system was originally developed for controlling wildland fires, the system was also designed to manage all types of events that would require coordinating a variety of resources to accomplish a specific mission. This system was used to manage the Hurricane Andrew incident and the recovery efforts. A number of specific topics, including information, safety, training, and logistics, are also discussed in this section.

The Incident Management Challenges and Innovations section addresses the challenges that were unusual to the Hurricane Andrew incident and highlights the innovations that were developed to meet these challenges.

Assessing the damages to park facilities began as soon as park staff emerged from their shelters, following the passage of Hurricane Andrew. A task force of engineers and architects from the National Park Service, Denver Service Center, surveyed the damaged facilities, identified repairs, and prepared reports outlining those damages and costs. Efforts were also made to stabilize and then restore the operational capabilities of the facilities. An overview of these activities are presented in the Facility Assessments and Maintenance Activities section.

In a similar vein, an assessment was needed of the effects of the hurricane on the natural and cultural resources that form the heart of south Florida and for which the parks were originally established to protect. A task force of scientists and technical specialists were recruited to assess these impacts, and an overview is presented in the Resource Assessments section.



South Florida National Parks

The subtropical environment of the south Florida region encompasses great expanses of internationally significant natural resources in proximity to one of the fastest growing urban environments in the United States. The three national parks that Hurricane Andrew impacted protect an aggregate of almost 2.3 million acres of marine, freshwater, and upland ecosystems (Figure 1).

Because the climate in the region is subtropical, winter temperatures are mild but occasionally drop to near freezing levels. Summer temperatures generally range from the mid-70s to the mid-90s. Rainfall averages 60-65 inches annually, with the majority of that falling in the wet season, which extends from May through October. The entire area is extremely flat, dropping with an almost imperceptible tilt from northern Big Cypress National Preserve to the ocean. Much of the area comprising Big Cypress National Preserve and Everglades National Park is perennially or periodically inundated with water.

The hurricane season extends from June 1 through November 30.

Big Cypress National Preserve

Big Cypress National Preserve was established in 1974 to protect the Big Cypress watershed from development proposals in the Big Cypress swamp, including the development of a new airport for Miami. The preserve boundary encompasses approximately 720,000 acres, with the major portion of the lands draining into the marine estuaries of northwest Everglades. The word "Big" refers not to the size of the trees found in the preserve, but rather to the expanse of the open prairies that are dotted with cypress trees, distant pinelands, and tree islands broken at intervals by dark forested swamps.



Big Cypress National Preserve • Biscayne National Park • Everglades National Park
U.S. Department of the Interior • National Park Service
160/169/176 • 20049 • DSC • 8/94

Figure 1. South Florida Region

The preserve's wild character is protected, but certain preexisting human uses are permitted, including hunting and trapping, oil exploration and development, and the use of the area on a subsistence basis and for traditional tribal ceremonies by the Miccosukee Tribe.

The preserve headquarters is in Ochopee. The primary visitor contact and park management facility is at Oasis. Few visitor developments exist. Visitation during late August is concentrated at the developed areas along U.S. 41 (Tamiami Trail), and in the backcountry where hunters establish hunting camps, preparing for the upcoming hunting seasons.

Facilities include a visitor contact/ranger station, maintenance shops, a fire cache, and offices for staff. Most of the employee housing in the preserve is at Ochopee and along the Loop Road. Some employees working at Big Cypress had homes in the south Dade area or had family living in the affected area.

Biscayne National Park

Biscayne National Park was established in 1968 and encompasses an area of 181,500 acres, including Biscayne Bay, substantial undeveloped mangrove shorelines, the undeveloped northern terminus of the Florida Keys, and the shoal waters between these islands and the Gulf Stream that include the northern-most living coral in the United States. The park is located 21 miles east of Everglades National Park.

Developed areas with facilities are Convoy Point (headquarters, marina, and visitor contact facility), Adams Key (information center and employee housing), Elliott Key (visitor center, day use, camping, and employee housing), and Boca Chita Key (camping and day use).

Visitors use the park heavily throughout the hurricane season. Visitors from the Dade County metropolitan area mostly use the park for daytime boating. Major activities include waterskiing, snorkeling, diving, and fishing. On weekend nights, several hundred boats anchor and dock inside the park boundary. During the summer, mosquito infestation precludes most land-based recreational activities. The Columbus Day Regatta, an annual special event, attracts several thousand boaters to the park during the early part of October.

At the time of the hurricane, 32 permanent employees worked at Biscayne. Five park employees and their families and occupants of four private inholdings lived in the park before the hurricane. Of the remainder that lived outside the park, approximately 63% lived in the Florida City/Homestead area and 37% lived in residential areas farther north. As a result, Biscayne had a higher percentage of

employees facing the full force of Hurricane Andrew than either of the other two parks.

Everglades National Park

Everglades National Park, the oldest and largest of the three parks, was established in 1947 with the mandate to preserve as a wilderness 1.4 million acres of southwest Florida, comprising of extensive areas of freshwater marl prairies, hardwood hammocks, coastal prairies, and marine and estuarine environments. This park was the first national park that was established to protect purely biological resources. An additional 107,000 acres, known as East Everglades, were added to the park in 1991. Everglades National Park is also designated a biosphere reserve, a world heritage site, and a wetland of international importance.

Visitation in 1991 totaled 1,347,643. The heaviest visitation is during the winter season. In late August and September, the park receives some of its lowest use.

The major facility development is at Flamingo, where a marina, lodge, and campground serve both land and water visitors. The Pine Island area contains the park headquarters, two visitor centers, a campground, a maintenance facility, and employee housing. Smaller developments are at Everglades City, Shark Valley, Tamiami, Chekika Hammock, and Key Largo.

Approximately 178 permanent employees worked at Everglades. Park housing existed for approximately 15% of that number. Of the remainder that lived outside the park, about 38% lived in the Florida City/Homestead area, 43% lived in residential areas farther north, and 19% lived in residential areas of the Keys, Everglades City, and Pinecrest areas.



The Chronology of Hurricane Andrew

BIG CYPRESS NATIONAL PRESERVE

BISCAYNE NATIONAL PARK

EVERGLADES NATIONAL PARK

August 18 - October 24, 1992



The Chronology of Hurricane Andrew

Narrative descriptions are provided for the Hurricane Andrew incident and recovery, from August 18 to October 24, 1992. The information was obtained from incident status summaries, incident action plans, unit log sheets, incident newsletters, unit files, radio logs, and interviews with park employees and incident personnel.

AUGUST 18 – TUESDAY

At 1700, tropical storm Andrew is 560 miles east of the Lesser Antilles, moving at 20 mph with 50 mph winds.

Big Cypress National Preserve, Biscayne National Park, and Everglades National Park have been in condition 4 of their hurricane plans since June. Each park automatically enters this condition at the beginning of the hurricane season.

On August 18, the fire management office at Everglades starts tracking tropical storm Andrew. Everglades initiates this tracking process whenever a tropical storm is named. The tracking program uses current storm path information and makes predictions as to the most likely route of future travel. This program tracks the storm through August 23.

Between August 18 and August 20, park operations are normal at the three parks.

AUGUST 21 – FRIDAY

At 0500, tropical storm Andrew is 430 miles north-northwest of San Juan, moving at 12 mph with 60 mph winds.

On August 21, the interagency fire center requests that 10 firefighters be dispatched to fires in Idaho. The request is approved, and the firefighters leave the south Florida parks for the assignment.

During the day, the commercial phone service goes out at the Everglades dispatch office and the Daniel Beard center. Only one phone line is available to support park operations.

Biscayne rents a U-haul trailer in accordance with its hurricane plan. The trailer is to be used for transporting records and property in case of a hurricane evacuation.

At 0500, Hurricane Andrew is 800 miles east of Miami, with 75 mph winds. An increase in strength is expected in the next 24 hours. At 1700, a hurricane watch is issued for Titusville, Florida, south to the Dry Tortugas, a coastal distance of approximately 425 miles.

Big Cypress National Preserve

Exxon Company, Inc., USA, operates two oil fields in Big Cypress. The company calls the superintendent and informs him that they will be shutting down the Raccoon Point oil facility, which is approximately 12 miles northeast of the Oasis visitor center, and the Bear Island facility at the north end of the preserve.

Biscayne National Park

Late in the afternoon, a call is made to Everglades to verify that the missile bay is ready for storing the Biscayne boats. Everglades staff checks the bay and verifies that it is ready.

The superintendent advises the Biscayne supervisors at 1800 to call all employees in their divisions and sections and have them report to park headquarters at 0630 to continue closure procedures.

The Biscayne vessels are pulled out of the water and secured at 2336.

Everglades National Park

Early in the day, the fire management office authorizes an overtime account to have the phone system repaired in the dispatch office. This system is repaired in the early afternoon. Hurricane preparations start at Key Largo and Everglades City midday. The decision to prepare for the hurricane is based on the weather reports. Everglades City staff, with previous experience with hurricanes, is concerned that a high-pressure system to the north could prevent the storm from veering north as other recent storms. Station shutters are installed, and the boats are pulled and tied.

During the day, resource orders for more firefighters to support fires in the western United States are received from the interagency fire center. After discussions with the superintendent, the decision is made to make no more commitments to send firefighters until the status of the storm is downgraded.

At approximately 1300, the superintendent decides that the Everglades hurricane plan will be implemented as soon as Dade County is put on hurricane watch. The superintendent designates the Pine Island district ranger as the park incident commander.

During the afternoon, contact is made with the southern interagency coordination center. The center is also tracking the storm and is aware of the potential situation that is developing.

At approximately 1606, dispatch is directed to call employees back to work to begin hurricane preparations. Everglades implements its hurricane plan. A radio announcement is made to all employees declaring condition 3 (a hurricane may threaten the area within 36-48 hours) and requesting that all employees report to their preplanned hurricane duty stations. Phone calls from dispatch to all employees continue throughout the night. The park incident commander notifies Biscayne and Big Cypress that Everglades is implementing its hurricane plan.

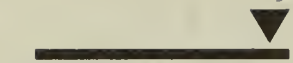
Flamingo rangers verify that no overnight visitors are registered in the backcountry. Earlier parking lot counts indicated that approximately 50 visitor boats were on the waters near Flamingo. The backcountry is closed, and hurricane warnings are posted at the backcountry desks.

Campers are notified and told to evacuate as soon as possible, but no later than the next morning.

The Flamingo district ranger contacts TW Recreational Services (TWRS) and directs them to evacuate the lodge at Flamingo by 0800 on Sunday, August 23. During this time of year, the lodge averages 40-occupied rooms/night.

All inbound Everglades traffic is stopped in the early evening to avoid complicating the evacuation procedures.

Other hurricane preparations include shuttering and securing all buildings, pulling and storing boats, covering and elevating office equipment, checking generators for emergency operations, and securing all loose materials. The missile base is reorganized to provide space for the boats assigned to each bay. The Chekika ranger station is secured and closed by late evening. The Key Largo ranger station is secured and evacuated by 2030. Hurricane preparations at Everglades City continue until midnight. The boats are taken to the water plant at Ochopee. Most employees are released around midnight and told to report back to work the next morning at 0600.



AUGUST 23 – SUNDAY

At 0500, Hurricane Andrew is 425 miles east of Miami, moving at 14 mph with 120 mph winds; at 0600 a hurricane warning is issued for the Florida east coast, from Vero Beach to the Dry Tortugas; at 0734, 375 miles east of Miami; at 1511, 280 miles east of Miami, with 150 mph winds; at 2100, 185 miles east of Miami, moving at 16 mph with 145 mph winds; and at 2300, 135 miles east of Miami with 140 mph winds, and a tornado watch is issued through 1100 of the next day.

Big Cypress National Preserve

The Big Cypress staff meets at 0700 at headquarters and goes over its hurricane plan. At 0917, Big Cypress initiates an emergency dispatch system. The preserve begins releasing staff by early afternoon to attend to personal needs.

At midafternoon, mandatory evacuation of low lying areas in Collier County is ordered. Traffic on U.S. 41 is bumper-to-bumper westbound. NPS staff stationed in front of the Oasis visitor center assists the evacuating south Floridians. Park staff provides evacuation information and keeps the visitor center open so evacuees can use the restrooms and get water.

At 1720, most of the staff are evacuated, and a minimal crew is on duty. By 2130, 14 employees evacuate to the Oasis visitor center while others remain at their residences.

By early evening, traffic has tapered off on U.S. 41. Traffic on Interstate 75 is reported packed as far north as Orlando. Hotels are reported full as far away as Jacksonville.

At 2200, rangers find a man riding a single-speed bicycle westbound near the visitor center on his way to Naples. The man has external pins to support a fractured lower leg. Transportation is provided. (He was later seen riding back toward Miami after the storm.)

Biscayne National Park

At 0530, the Biscayne hurricane plan is implemented, and employees are notified by phone to return to the park. At 0830, the boats are loaded and transported to the missile base at Everglades; they are secured by 1600.

Patrols of the Keys and waters are completed, and all boaters and residents are advised to evacuate. One boater at Elliott Key refuses to leave after numerous warnings. Later that night, the U.S. Coast Guard evacuates this boater, at his request. Biscayne rangers evacuate, after long and intensive persuasion, two private citizens on Elliott Key and adjacent Porgy Key (a 66-year-old female and a 93-year-old male). Both residents have a long and colorful history in the Biscayne National Park area. Another resident remains and rides out the storm in the house on the Ragged Keys.

Residences, buildings, and facilities on the Keys are secured and evacuated. Biscayne employees are released at 1500.

The concessioner at Biscayne is told early in the day to move his boats out of the marina and anchor them according to the hurricane plan. When the chief ranger

returns later that afternoon from transporting boats, the concessioner is gone and has not moved his boats.

At 1830, the gate to Biscayne National Park is closed and locked.



The chief ranger and two other people from Biscayne evacuate to Pine Island in Everglades, at approximately 2330. The Elliott Key and Adams Key residents decide to drive north.

Everglades National Park

At approximately 0230, the southern interagency coordination center calls to relay a message from the Monroe County emergency operations director that Flamingo should be evacuated. Dispatch informs the center that Flamingo is being evacuated.



At approximately 0600, employees return to work to complete hurricane preparations. A briefing for the park incident management team is held at 0630. The decision is made to send employees home at noon.

Early in the morning, the boats from Flamingo arrive at the missile base and are secured in their assigned bays. One boat is left hoisted in the Flamingo marina.

A helicopter overflight is completed over Florida Bay. Boaters are contacted and notified of the hurricane warning.

Early on August 23, only two boat trailers are left in Flamingo, and air reconnaissance indicates that these two boats are headed in from Whitewater Bay. By 0900, visitors at the Flamingo lodge and campground are evacuated. TW Recreational Services implements its hurricane plan and secures its facilities. All TWRS employees are evacuated to shelters in Homestead by Sunday afternoon.

Fort Jefferson reports that hurricane preparations are almost complete at 0918, with three private vessels planning to ride out the storm anchored near the fort. A little after midnight, a Fort Jefferson vessel had been contacted. The captain of this vessel notified dispatch that he was monitoring the situation and would anchor the boat in the location that the U.S. Coast Guard indicated.

At 1000, the East Everglades staff completes hurricane preparations and evacuates to Pine Island. At 1130, the superintendent and assistant superintendent inspect the headquarters and Pine Island areas. Between 1200 and 1400, employees that are not assigned to evacuate to the Pine Island area are released. The park incident commander is released to go home, and the Pine Island staff ranger is assigned to be the park incident commander.

The Shark Valley staff continues securing facilities there and at the Tamiami ranger station, trail center, and the environmental education center on the Loop Road. They finish at noon.

Early in the morning, the Everglades City staff videotapes the Gulf Coast ranger station facilities. The facility is closed at noon, and park staff reports to assigned evacuation areas. The backcountry is secured at 1334.

At 1500, the Flamingo residents begin to move their personal belongings to Pine Island.

At 1800, the Washington and the Southeast Regional Offices are contacted and the current status is discussed. The possible need for the Type I Incident Management Team is also discussed.

At 1926, the last two Flamingo rangers are enroute to Pine Island. Flamingo is secured, and the park roads are checked for any remaining visitors.

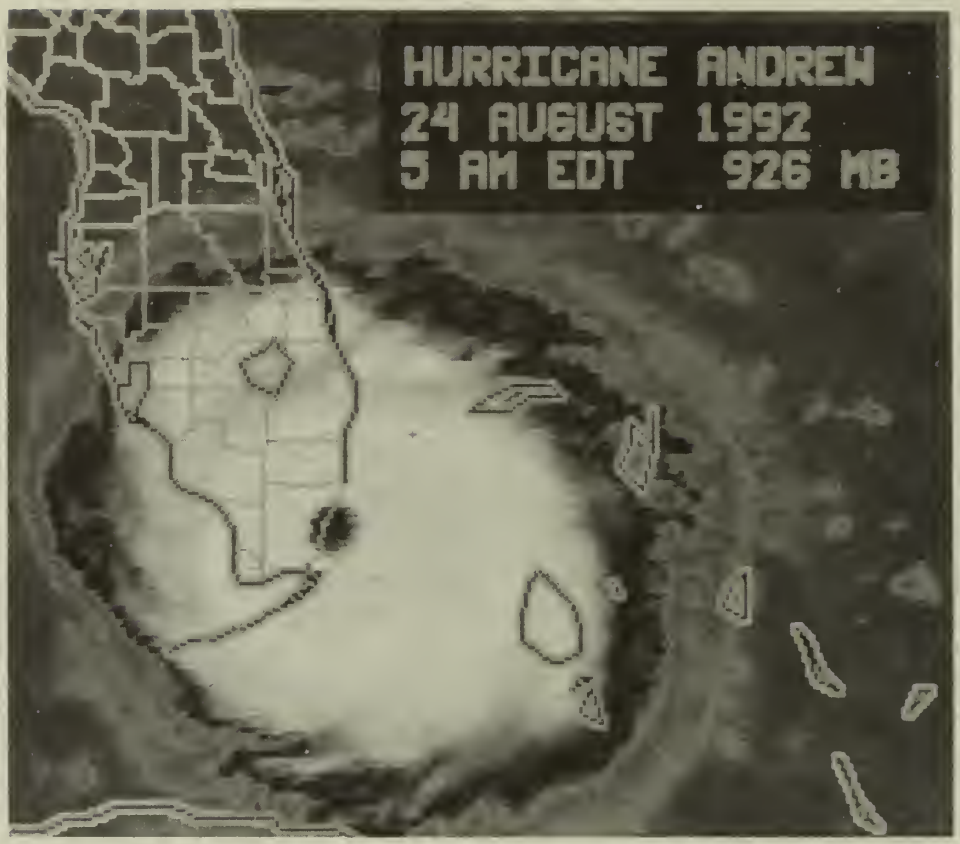
The plan is followed for evacuation: the Flamingo, Key Largo, and East Everglades residents evacuate to Pine Island in Everglades; Everglades City and Gulf Coast residents evacuate to the Oasis visitor center in Big Cypress; and Fort Jefferson residents remain at the fort.

After everyone arrives at Pine Island, the park incident management team assesses the current building assignments as reports of the intensity of the hurricane are received. Because of the pine trees in the area around the Pine Island housing area, people staying in these residences are strongly encouraged to move to the Pine Island ranger station, supply building, or dispatch office at headquarters. Some elect to stay because they do not want to leave their pets.

Everyone settles in to wait for the storm. Dispatch continues to monitor the weather reports during the night. Employees remain at the entrance to maintain security until the storm arrives.

AUGUST 24 – MONDAY

At 0010, Hurricane Andrew is 110 miles east of Miami and is expected to pass over Everglades by 0700. At 0039, a report is received that tropical storm-force winds are starting at Fort Lauderdale. At 0105, Hurricane Andrew is 85 miles east of Miami, moving at 17 mph, with 135 mph winds. Hurricane-force winds are expected between 0300-0400, with the eye expected to be over Cutler Ridge, Homestead, and Florida City. By 0300, Hurricane Andrew is 40 miles east of Miami. Hurricane-force winds are predicted to extend 30 miles from the center of the hurricane, and a storm surge of 5-7 feet is predicted. At 0505, Hurricane Andrew makes landfall, with wind gusts over 160 mph.



Big Cypress National Preserve

At 0530, sustained winds of 106 mph are reported at the Oasis visitor center. Big Cypress calls Everglades dispatch, but the staff has difficulty understanding them due to the noise from flying debris hitting the headquarters. The storm passes through Oasis between 0700 and 0800.

At 1156, the preserve reports that U.S. 41 is passable and that the repeater is down. Security patrols of Big Cypress and Everglades City are initiated at 1200. At 1349, the first reports of major damages at Everglades are heard at Oasis while monitoring the Everglades radio traffic. Videotaping of the facility and resource damages is completed.

Naples loses power at 0800 but never loses phone service. Big Cypress staff go there to relay phone calls from employees at Everglades to concerned families. They also go to the Florida Panther Refuge work center to make calls.

Biscayne National Park

After spending the night at Pine Island, the Biscayne chief ranger and the ranger's clerk leave Everglades at 1357 to attempt to reach their homes in Homestead. During the trip, trying to avoid downed powerlines, poles, trees, and debris in the road, a utility line catches the light bar on the chief ranger's vehicle, ripping the bar off. The trip takes 3 hours to travel 25 miles.

Everglades National Park

At approximately 0330, all staff are evacuated to their assigned buildings at Pine Island and park headquarters. At 0354, the power and phones go out. The generator for the dispatch office automatically starts. The last broadcast from the National Oceanic Atmospheric Administration is received at 0445. By 0500, rain and high winds arrive. At 0538, the eye of the hurricane is reported to be over Homestead. The eye does not pass over the headquarters and Pine Island areas.

At 0600, staff assesses the damages to the buildings they are occupying. Leaking roofs, broken windows, and flooded areas are reported. The first quick assessment of the visitor center indicates that the building has received major damage. Water damage is discovered in most of the facilities. The park incident management team decides to wait until daybreak to assess the area outside. There is a safety concern about falling trees, branches, and debris.

At daybreak, work teams form to survey the residences and to check the roads. The staff spends the day assessing the damages, cutting trees, clearing roads, and preparing residences for occupancy. The water system is brought back on-line at Pine Island. Everyone is warned that the water is not potable.

Saw teams and a front-end loader are used to clear the road between Pine Island and headquarters. At 1230, the road is opened, one-lane wide. The roads to the entrance and to Royal Palm are passable with four-wheel-drive vehicles. By early afternoon, a reconnaissance of the road to Flamingo is completed. Flamingo is accessible, but clearing is needed. The road to the Daniel Beard center is inaccessible.

At approximately 1430, a dozen TWRS concessioner employees arrive at the entrance to the park and ask to be allowed to go to Flamingo to stay. The ranger stationed at the entrance explains that no power or water is available at Flamingo and that they cannot stay in the park.

Early afternoon, dispatch receives a report from Everglades City that the trailer stilts have been damaged and that the visitor center is damaged and flooded. Work begins on stabilizing the damage and making the residences livable.

Reports from residents of the nearby island of Chokoloskee indicate that the surrounding bay was blown dry during the storm. Concession boats anchored in the Barron River near Everglades City are not damaged.

The Key Largo and East Everglades rangers leave Pine Island in the afternoon to travel to their stations to assess the damages. At 1605, the East Everglades staff reports that the Chekika ranger station is a total loss.

The park incident management team tries to call out on a cellular phone from 0735 until 1136. They successfully contact the Southeast Regional Office and the Washington Office. The park team requests that the Type I Incident Management Team, a special events team, and a skilled maintenance team be sent as soon as possible. The destruction and the devastation from the hurricane are explained. The regional office requests that the park call back in the afternoon. When park staff contacts the southern interagency coordination center later that afternoon, no information is available on the request for the Type I Incident Management Team.

A briefing is held at 1800 for all of the employees and families in the headquarters and Pine Island areas. Work assignments for the next day are discussed and assigned.

Curfew in south Dade County is set from 1900 to 0700.

AUGUST 25 – TUESDAY

At 0537, Hurricane Andrew is 270 miles east of New Orleans, moving at 17 mph, with 140 mph winds.

Big Cypress National Preserve

The superintendent contacts the South Florida Water Management District regarding helicopter support. The district responds and dispatches a helicopter to Oasis. The helicopter picks up two Big Cypress rangers who are transported to Biscayne National Park to provide security.

A dispatch office and a supply depot are established at Oasis to assist with the incident. Supplies, food, and generators are ordered and brought in through Fort Myers and Naples.

At 1000 the first overflight of the area takes off from Oasis to assess the damages. The observers also fly over Biscayne and Everglades.

Big Cypress staff begins transporting supplies to Everglades. That evening, drivers to the Homestead area report that travel from Oasis by way of U.S. 41 and Krome Avenue is clear but slow. One-way trips to Pine Island take 4-5 hours, with numerous flat tires.

By August 25, security staff at Big Cypress is seeing an increase in law enforcement incidents.

Biscayne National Park

The chief ranger attempts to travel to the park and discovers that the road to Convoy Point is blocked by trees and debris. He is able to walk into the area. The temporary visitor center and administrative offices have sustained major damages. The two boats left in the marina by the concessioner have been damaged.





During the afternoon, an overflight of the Biscayne Keys is requested, and an initial assessment is made of the damages.

An employee from the Key Largo National Marine Sanctuary provides initial patrols of Biscayne Bay until the boats that are stored at the missile bays in Everglades can be trailered back to the park.

The chief ranger broadcasts to all Biscayne employees three times a day to establish contacts with park employees. The two radio repeaters have been destroyed; broadcasts are done from mobiles using Everglades frequencies. The cellular phone generally does not work during the day. Attempts to contact the Southeast Regional Office are unsuccessful.

Everglades National Park

After attempting to contact the southern interagency coordination center all through the night on the cellular phone, contact is made at 0240. The request for the Type I team is repeated. At that time the center still does not have any information on whether a team has been ordered. The park places orders for supplies and food.

At 0700, power and telephone service is restored to Everglades City. The Everglades City staff attempts to contact the regional office and interagency center and is successful before noon. The superintendent relays a message through Everglades City at 1151 requesting the Type I team. At 1210, Everglades City notifies dispatch that the Type I Incident Management Team is enroute to the park and will arrive early Wednesday.

Around 1300, dispatch for the park is set up at the Gulf Coast ranger station. Resource ordering begins out of Everglades City. Everglades City staff operates communications for the park incident management team until phones are installed at headquarters.

Everglades continues to assess the damages. A few employees return to the park. Roads are cleared and residences repaired. Staff begins videotaping the area. The missile bays are cleared and used as storage areas. Boats are launched at Key Largo and Flamingo. Rangers conduct boat patrols of the backcountry. The road between Flamingo and the park entrance is cleared. Two employees return to Flamingo to provide security for the area. A couple of the phones in Flamingo are still working and are used by the park incident management team.

The U.S. Coast Guard conducts patrols along the west coast of Everglades. Attempts are made to contact boaters who weathered the storm in that area.

AUGUST 26 – WEDNESDAY

At 0100, Hurricane Andrew is 91 miles west of Lafayette, Louisiana, with 125 mph winds.

A special events team arrives at 0900. They are assigned to security checkpoints, saw teams, and salvage teams for supplies and emergency equipment. The Type I Incident Management Team arrives at Everglades National Park at 0930.

At 1100, the three park superintendents sign a delegation of authority to the Type I incident commander and the Incident Management Team.

> Initial objectives for the Type I team include providing for personnel safety, securing and protecting resources and facilities, assisting park personnel and their families in dealing with emergency and interim needs, assessing all park facilities for damage, coordinating the recovery effort with park concessioners, reestablishing safe and healthy conditions to operate in the upcoming season, and assessing and developing a strategy with priorities.

At 1800, a debriefing for the park incident management team is conducted. The first incident status summary is prepared. Personnel assigned to the incident numbers 82.

During the day, Everglades City notifies the incident commander that a satellite telephone system has been ordered and is on its way. The team continues to use the phones at Flamingo to place orders and establish logistics.

The death of a Fort Jefferson employee is reported by his wife to park staff. He died as a result of structural damage to his home in Homestead during the hurricane.

Park staff works on clearing debris, opening roads, stabilizing residences, and operating generators.

Florida National Parks and Monuments Association staff arrives to inventory and work on salvage of association property. The director of the association declares a near total loss of inventory, extensive water damage, and roof damage.

A husband and wife team from the Federal Law Enforcement training center in Glynco, Georgia, arrive at Pine Island approximately 48 hours after the storm, in a large four-wheel-drive vehicle towing a utility trailer. Employees at the training center had seen the devastation of the area on television and decided to initiate a response as fast as they could to send items that they thought would be the most needed. These supplies (diapers, food, clothing, toothpaste, roofing material) were desperately needed at that time and were quickly distributed.

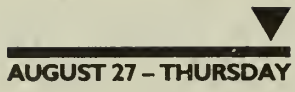
The employee assistance teams are deployed to the homes of employees in the outlying areas to establish contact. The teams assist employees and their families with moving their possessions, stabilizing their residences, finding places for them to stay, and notifying their families. Teams sent to Homestead face traffic control problems, heavily damaged vehicles using the roads, downed powerlines, unstable houses,

martial law, law enforcement situations, strong thunderstorms, rescuer-victim conflicts, people in shock, and health risks (tetanus and hepatitis).

A preliminary damage evaluation of all the parks is completed by air.

The Incident Management Team activates the critical incident stress debriefing (CISD) team to arrive on Thursday, August 27.

An offer of help is received from Loxahatchee National Wildlife Refuge, U.S. Fish and Wildlife Service, Florida.



AUGUST 27 – THURSDAY

The Incident Management Team begins to organize and plan the logistics for operating. The priorities for dealing with the recovery from Hurricane Andrew include employee and human welfare, park facilities, and rebuilding.

The employee assistance teams continue to locate other NPS employees. Recognizing that most of the homes of park employees have had major damage, administrative leave is authorized until basic needs are met. By the end of the day, the employee assistance teams have contacted all but 16 Everglades, 2 Biscayne, and 1 Big Cypress employees.

The crew of firefighters from the south Florida national parks is scheduled to leave Boise, Idaho, on August 28 to return to Florida.

A satellite phone system is installed at Everglades headquarters but is quickly found to be nonfunctional. Another satellite system is ordered. The management and the logistics of the incident are severely hampered by having no phone and limited radio communications.

Resources begin to arrive; 130 personnel are assigned to the incident on August 27. Resource orders are put on hold, however, until food and lodging are available to support the people that are being requested. A few supplies from different agencies begin to trickle in to the Big Cypress supply center. Two 28-foot trailers from Big Cypress are sent to Biscayne to serve as temporary office space.

The NPS deputy director and the Southeast Region (SER) regional director tour the devastated area during the day. The undersecretary of the interior requests a status of the damages and a list of needs and associated costs.

The governor of Florida calls out the National Guard for protection.

Offers of help in all forms are received from other parks and NPS employees. A mailing address is publicized, and letters of support begin arriving, eventually reaching a peak of 25-30 per day, plus packages.

Exxon fully resumes oil operations at the Raccoon Point and Bear Island facilities in Big Cypress.

Three branches are established under the Incident Management Team to manage the operations of the incident and the recovery of the south Florida national parks. Branch directors are selected and assigned tasks. Their objectives are to salvage and secure the areas and prevent further damage. The parks remain closed to the general public.

The employee assistance teams continue to contact and assist employees. The teams move and transfer employee and family belongings to the missile base, help board up windows, waterproof roofs, find temporary quarters, and provide cash advances. All employees are finally accounted for by Sunday, August 30. Some contacts are made through neighbors and other family members who know the condition of the employees.

The CISD team starts debriefing the employees and their families. Safety and medical concerns expand. The director/physician at Baptist Hospital Medical Control gives full authority for park medics to give drugs, medications, and intravenous therapy.

By the end of the week, the employee assistance teams have contacted over 600 park employees and family members. The personal effects of 40 families are moved to park storage, and 57 employee homes and 27 buildings are stabilized. About 100 generators are acquired and distributed. The teams deliver 370 sheets of plywood, 300 rolls of tar paper, 100 boxes of nails, and 100 rolls of plastic to residences. Briefings on insurance and damage claims are held for employees and families (52 families attend). An 800 number for employee assistance is established.

The second death attributed to the hurricane is reported on Saturday, August 29. A body is discovered at Adams Key near the location where three recreational boaters had moored after the park was evacuated on August 23.

On September 3, the superintendent of Big Cypress signs an order to close the area of the preserve below the Loop Road to all entry until June 1993. Damage to hardwood hammocks, in particular, has raised concerns about hunting pressure on deer during the upcoming hunting seasons due to lack of cover.

By September 3, 280 personnel are assigned to the incident. The cost to date is $625,000.

Communications and housing continue to be the primary logistical problems. The second satellite telephone system arrives and is set up at headquarters. Communications continue to be a problem between headquarters and the outlying areas. Repeaters are down, making radio communications unsatisfactory.

A contract for lodging and meals is negotiated with TW Recreational Services for using the Flamingo lodge and restaurant.

The first edition of the South Florida Parks Courier, the incident newsletter, is issued during the week.

An employee-victim needs list is sent to the Washington Office and is then canceled when the decision is made that money would be more appropriate than supplies.

The Hurricane Andrew Relief Fund is set up to accept donations from across the nation.

Generators become commonplace throughout the parks. The ground support unit develops plans and user guides for the generators.

Repair crews continue to clean up debris, clear roads, reroof residences, and secure facilities from receiving more water damage.

The upcoming Labor Day holiday weekend prompts concerns about heavy visitation to Big Cypress.

SEPTEMBER 4 – FRIDAY
SEPTEMBER 10 – THURSDAY

Emergency repair of park employee residences is largely completed by September 4. The main focus during the week is now on restoring residences and facilities to make them suitable for use and occupancy. Debris clearing, road openings, and cleanup continue.

A temporary roof over the Everglades curatorial collection is completed, and a reliable power source is installed. A 20-person Type II crew and curator recover and salvage documents and artifacts from the Daniel Beard center and the South Florida research center. A contractor is brought in to freeze-dry the documents and separate them.

An underground powerline contract for Everglades is awarded. The contractor plans to work 24 hours a day, 7 days a week, and expects completion in 60-90 days.

A filming plan to chronicle recovery in the south Florida parks is developed.

Removing storm-damaged materials and vegetation is ongoing in all three branches.

Surveys for contaminants in the parks are conducted, and a contract for removing hazardous materials is negotiated to cover the three parks.

The task forces that will assess facility damages and the effects of the hurricane on the park resources are identified. The facility assessment task force from the Denver Service Center arrives between September 6 and 9 and begins evaluating the damage to structures in all three parks.

Maintenance crews continue to expand the scope of the repair operations.

Work begins to restore fire initial attack capabilities and the fire management operations and to develop a hazardous fuel reduction plan.

Plans are formulated to obtain modular units for Convoy Point, Daniel Beard center, Everglades headquarters, and Pine Island for temporary office space.

The employee assistance teams continue to evaluate the needs and conditions of the employees, deliver generators, and assist with the moving of personal belongings. Displaced families and incident personnel are housed at Flamingo.

Two days off per week are scheduled for all park employees. All incident personnel are assigned to 21-day schedules.

A stress management contract for two years is negotiated to provide on-site services for employees of the three parks. Critical stress debriefings are conducted for employees of all three parks and Fort Jefferson.

Over 200 tetanus boosters are given to incident personnel and park employees and their families. All government residences are on-line, with generators installed.

The NPS director, SER regional director, and NPS comptroller tour the parks and meet with the three superintendents and the Incident Management Team.

A Branch III CISD team traveling to Big Cypress is third on the scene of a motor vehicle accident with two fatalities on U.S. 41.

Archery season (hunting) opens in Big Cypress on September 5.

By September 10, 320 personnel are assigned to the incident and the cost to date is $2,340,000.

SEPTEMBER 11 – FRIDAY
SEPTEMBER 18 – THURSDAY

General repair and cleanup projects continue. Some of the cleanup crews move to the more outlying areas.

Hazardous fuel inventories are conducted to determine the extent of changes after the hurricane.

The Incident Management Team manages the fire program for the parks until September 18. On September 10, a prescribed natural fire (9278, Second Bay) results from lightning and is certified in accordance with NPS fire management guidelines. The fire is in the prescribed natural fire management unit and reaches 150 acres in size. In the East Everglades subdistrict, a lightning strike on September 12 produces a wildfire (9279, Rutzky's #2) that is rained out within the hour.

The resource assessment task force initiates its work on September 15, starting with a scoping session with park staff to identify existing information, questions that need to be answered, and methodologies that will be used to assess the resource damages.

The NPS lands office in Naples contracts for 30 rental units at Key Largo to be used as temporary quarters for park employees.

Donated supplies from other parks arrive and are made available to park employees.

The employee assistance teams are receiving up to 40 calls a day from affected employees.

A cost estimate of $50.7 million for Hurricane Andrew damages to the south Florida national parks is provided to the Southeast Regional Office and the Washington Office.

Personnel assigned to the incident peaks on September 15 at 377. Temporary office trailers for the Incident Management Team are delivered to Everglades.

Other resources on the incident include 100 small and 20 large generators that are generating approximately 2.2 megawatts of power, 2 chippers, 2 mobile and 12 hand-held mosquito foggers, a satellite phone system capable of providing 44 phone lines, 6 dump trucks, 4 helicopters, and 2 fixed-wing aircraft. Many incident personnel reach the end of their 21-day maximum assignment and are rotated out of the incident.

Reroofing and debris hauling continue. Chippers are used to reduce the volume of debris.

The Eastern National Parks and Monuments Association reports a total of $95,000 in the Hurricane Andrew Relief Fund.

In response to increasing inquiries about opening the parks to visitors, Everglades issues a news release on September 18 on the current and projected future status of visitor facilities.

Incident costs reach $3,350,000, with 356 personnel assigned on September 18.

SEPTEMBER 19 – SATURDAY
SEPTEMBER 27 – SUNDAY

Debris cleanup in all areas continues, with more and more emphasis on remote areas. The U.S. Army, 92nd Engineering Battalion, Heavy, begins cleaning up debris in Chekika on September 21.

Commercial power is restored to Everglades headquarters and Pine Island on September 21 at 1445, and to Shark Valley and the Tamiami ranger station area on September 23. Utility hookups of individual buildings continue.

The Denver Service Center issues the notice to proceed on constructing the underground powerline to Flamingo September 24, and a preconstruction briefing is held September 29.

With the return of the Everglades park staff to duty, the Incident Management Team moves out of headquarters and into the modular structures on September 21-22. Many other incident functions move out of park facilities and into modular structures during the week of September 24.

The resource assessment task force wraps up their work with a closeout briefing for the Incident Management Team, park staffs, and the SER regional director on September 25. The facility assessment task force also provides a preliminary briefing on September 25 and completes its reports for the three parks on September 30.

An interim hurricane plan for Big Cypress, Everglades, and Biscayne is approved September 27. The plan will carry the parks through the end of the 1992 hurricane season and addresses the problems of preparing for a new hurricane, with the potential of having upwards of 200 incident personnel on-scene in addition to regular park staff.

Visitor facilities at the Gulf Coast ranger station in Everglades City open on September 21. The concession boat tours resume their normal schedule. The backcountry remains open for day use only.

Security personnel at the Everglades main gate turns away 147 park visitors on September 26.

Personnel assigned to the incident totals 347 on September 19 and 332 on September 27. On September 22, 80 personnel demobilize, but some replacements continue to arrive. As of September 26, one rotary and two fixed-wing aircraft remain available to the incident.

Expenditures as of September 27 are $4,601,152 and checks issued by the administrative payment team exceeds $1,000,000 on that date.



SEPTEMBER 28 – MONDAY
OCTOBER 8 – THURSDAY

General repair and cleanup projects continue. Many projects focus on visitor facilities so that portions of the parks can be opened to visitor use. A Type I interagency hotshot crew cleans up fallen trees in the Long Pine Key campground in Everglades. Approximately 2,400 trees are removed from that area. The crew also works in the Pinecrest area of Big Cypress.

Although the Columbus Day Regatta at Biscayne National Park is canceled after the hurricane, park staff and the Incident Management Team recognize that significant

numbers of people may show up anyway. Debris from near-total destruction of park facilities is still strewn about on the Keys, awaiting removal through a cleanup contract. Work is progressing on repairing some facilities, but Biscayne is not equipped to handle large numbers of people or to manage the situation, so this becomes a function for the Incident Management Team.

On September 29, the team prepares a plan to deal with the situation that is expected to occur October 8-12. The plan creates a group E under Branch I and identifies personnel requirements, logistical needs, and operational period plans. A total of 30 persons and 8 boats are needed, along with equipment, food, and supplies to stay on the Keys for four nights. Event objectives are to provide for the security and closure of lands in Biscayne National Park, to protect the natural and cultural resources of the park, and to provide for the safety and well-being of NPS personnel.

Branch III is deactivated on October 6, and authority is redelegated for Big Cypress and the Shark Valley area of Everglades to the respective superintendents. The transition from the Type I Incident Management Team to a Type II incident organization occurs during the week of October 6, with the Type I incident commander demobilizing on Thursday, October 8.

Expenditures as of October 8 are $5,381,339, with 278 personnel assigned to the incident.

OCTOBER 9 – FRIDAY
OCTOBER 24 – SATURDAY

The Type II incident management team takes command on October 8, and establishes objectives for the remainder of the incident. These objectives are as follows:

- Continue the incident and recovery objectives of the Type I Incident Management Team.
- Finish the project list of Branches I and II by October 24.
- Downsize incident staff and functions when and where possible.
- Identify and implement cost-saving measures when and where possible.
- Demobilize the Type II organization by October 26.
- Identify and document functions and procedures needed to support the facility rehabilitation projects at Big Cypress, Biscayne, and Everglades by October 26.

The focus of the Type II team is on preparing the three parks, both physically and administratively, to regain management of their parks. Cleanup and repair activities are an emphasis of the operations section. Repair and reconnection of utility systems, repair of housing and offices, and cleanup of campgrounds, roads, and trails and other visitor use areas are primary projects. An estimated 95% of the identified tasks are accomplished before the transition back to park management.

Planning, logistics, and finance sections establish an accurate account of incident costs and steadily work towards downsizing the incident staff during the Type II management. An important accomplishment in preparing the parks to resume management is preparing a transition plan. That plan is approved on October 20.

The Columbus Day Regatta reaches an estimated peak of 1,800 boats on October 12. One medical evacuation occurred. Numerous warnings are issued to individuals trying to access the Keys. In implementing the regatta incident management plan, 21 personnel are assigned to the October 11 and 12 day shift while an additional 7 take the night shifts. The Regatta law enforcement group demobilizes on October 13.

Commercial power is returned to the Biscayne headquarters area on October 11. Utility systems are repaired at Elliott Key, and on October 18, trailers are moved to the Biscayne headquarters area to serve as temporary offices. An eight-person Cape Hatteras seasonal maintenance crew is brought in to assist in bringing essential services back on-line.

In Big Cypress, incident personnel continues to clean up debris and complete repairs to buildings. Work on park housing in Everglades City is completed on October 9. Work on park housing and visitor facilities in Shark Valley continue during October, and much of the work is completed by October 24. Similar work occurs in Everglades between October 9-24 under the direction of the Type II team.

Incident personnel working on the Big Cypress portion of the incident are demobilized on October 21. Remaining control of the Hurricane Andrew incident and recovery is transferred back to Everglades and Biscayne on October 24 at 1400. The Type II team demobilizes on October 25.

As of October 24, cost of the incident is $6,795,972.



The National Park Service Response



Hurricane Preparedness Planning

Management Direction

The National Park Service *Management Policies* (U.S. Department of the Interior, National Park Service 1988) states:

> The National Park Service will develop a program of emergency preparedness in accordance with the Federal Civil Defense Act (50 *United States Code* 2251 et seq.), National Security Decision Directive Number 259 (February 4, 1987), departmental policy, and other considerations at the Washington, region, and park levels. The purpose of the program will be to maximize visitor and employee safety and the protection of property.
>
> NPS emergency operations will be conducted utilizing the Incident Command System (ICS) of the National Interagency Incident Management System (NIIMS). Each park superintendent will develop and maintain an emergency operations plan to ensure an effective response to all types of emergencies that can be reasonably anticipated.

Hurricane Planning in South Florida

The national parks along the Gulf Coast and the East Coast can reasonably anticipate that a hurricane, with its associated high winds, storm surges, heavy rains, and tornados, could strike with only limited warning at anytime during the hurricane season. Park preparation is likely to reduce deaths, injuries, and property damage associated with hurricanes.

The south Florida area is particularly prone to the damaging effects of hurricanes and other tropical storms. Since 1900, 41 hurricanes have struck the south Florida coast.

Hurricane Plans of South Florida National Parks

Each of the parks in south Florida has a hurricane plan that is periodically revised. These plans are discussed each year with employees at the beginning of the hurricane season.

The three plans are quite similar in concept. Each plan institutes a streamlined central command when a hurricane threatens. Each plan assigns specific responsibilities to individuals or divisions, and each plan is organized around four condition levels.

Hurricane Preparedness Condition Levels

At the beginning of each hurricane season (condition 4), each park has instructions on how to prepare for a hurricane. These preparations include monitoring weather broadcasts, tracking any existing tropical storms, securing buildings and equipment, stocking hurricane shelters, informing park employees of the hurricane plan, and outlining each person's responsibilities at work and at their residences.

Condition 4 — Hurricane Season.

Condition 3 — Hurricane Watch. Hurricane is present and may threaten area within 36-48 hours.

Condition 2 — Hurricane Warning. The specific area has been targeted as a possible land fall location. Hurricane-force winds are expected within 24 hours.

Condition 1 — Hurricane-force winds are occurring.

Under condition 3, emergency operations commence. Park operations are centralized under the Incident Command System. Public facilities are closed, and visitors are assisted in evacuating the parks. Buildings and equipment are secured. Communications are established with the other parks and the Southeast Regional Office to inform others of the hurricane watch status.

Under condition 2, preparations of park facilities are terminated, and employees are released to complete personal preparations for evacuating to safe locations.

Each plan includes safety information and instructions that are to be used during the passing of a hurricane (condition 1).

After hurricane passage, each plan contains instructions for employee status reporting; search, rescue, and protection of property; salvage and rehabilitation activities; and reporting procedures. Each plan also contains several appendices that may include phone lists of park personnel, ICS information, park liability information, detailed operation procedures, hurricane shelter equipment lists, inholder evacuation documents, and hurricane safety articles.



Path of Hurricane Andrew

Hurricane Andrew developed into a tropical storm on Monday, August 17, 1992. Andrew grew to hurricane strength on August 21. Andrew remained at hurricane strength as it passed over the Bahamas, south Florida, the Gulf of Mexico, and Louisiana. The hurricane weakened and dissipated within a few hours of moving inland on August 26.

Origin of Hurricanes

Hurricanes obtain their strength and power from the solar energy that is stored in the warmth of tropical seas. Moist air rising in tropical updrafts cools and causes water to condense forming clouds. Energy is released through the condensation process that heats the air increasing the updraft. If conditions are favorable, this "heat engine" powered by the energy of condensing water grows. More moist air is drawn in and lifted upward. More water is condensed releasing more energy. More energy produces stronger updrafts that draw in more moist air. A hurricane develops.

The spin of the earth deflects the air flowing into a large storm causing it to spiral inward. This deflection turns the winds causing a counterclockwise flow into an area of rising air.

From small areas of tropical updraft, a hurricane can grow. When maximum sustained winds reach 39 mph, the disturbance is classified as a tropical storm and named. If the tropical storm continues to grow and sustained winds exceed 74 mph, the storm is classified as a hurricane. Hurricanes are classified by strength using the Saffir/Simpson hurricane scale (Table 1).

Hurricanes contain a relatively calm "eye" in the center of the swirling updraft of powerful winds that form the "eye wall." The eye is an area of gently descending air. An observer experiencing the passing of the eye of a hurricane will first be subjected to increasingly fierce winds. As the eye arrives, the winds will diminish to near calm, and the open sky may be observed through thinning clouds. As the second portion of

the eye wall arrives, violent winds blowing from the opposite direction will arrive and then gradually diminish as the hurricane moves on.

TABLE 1. SAFFIR/SIMPSON HURRICANE SCALE

Category	Windspeed (mph)	Central Pressure (millibars)	Storm Surge (feet)	Damage
1	74 – 95	≥980	4 – 5	Minimal
2	96 – 110	965 – 979	6 – 8	Moderate
3	111 – 130	945 – 964	9 – 12	Extensive
4	131 – 155	920 – 944	13 – 18	Extreme
5	>155	<920	>18	Catastrophic

Regional Hurricane Phenomena

South Florida is located in the North Atlantic tropical cyclone basin. The basin includes much of the North Atlantic Ocean, the Caribbean Sea, the Gulf of Mexico, and the coastal areas of the United States, from Texas to Maine.

Hurricanes form most often when sea temperatures are at their annual maximum. The hurricane season for the North Atlantic basin generally extends from the first of June until the end of November. Hurricanes are most likely to occur during the months of August, September, and October. In a typical year, the North Atlantic basin could have as many as 10 tropical storms; 6 of these could evolve into hurricanes and 2.5 into major hurricanes (equal to or greater than category 3).

The track a hurricane follows is determined by even larger flows in the atmosphere. High-pressure systems, such as the "Bermuda high," that commonly form during the hurricane season, steer hurricanes around them in a clockwise path. Low-pressure systems steer the hurricane in a counterclockwise direction. These atmospheric highs and lows are constantly moving, growing, and shrinking. This complex swirling of the atmosphere combines with the spinning inertia of the hurricane itself to determine the path of the hurricane.

Hurricane Andrew

Hurricane Andrew developed from a small tropical disturbance that crossed from the west coast of Africa to the Atlantic Ocean near latitude 15 north on August 14, 1992. The disturbance traveled westward, gradually increasing in strength (Figure 2).

At 1400 on August 16, the disturbance acquired enough organization to be identified as a tropical depression.



Big Cypress National Preserve • Biscayne National Park • Everglades National Park
U.S. Department of the Interior • National Park Service
160/169/176 • 20050 • DSC • 8/94

Figure 2. The Track of Hurricane Andrew

At 0800 on August 17, the tropical depression had grown in strength. This depression now contained sustained winds of at least 39 mph, and had become the first Atlantic tropical storm of the 1992 season and was given the name Andrew. For the next few days, Andrew traveled first west under the influence of a high-pressure system to its north and then decelerated and moved northwest under the influence of a low-pressure system. Shifting upper level winds associated with the low drew off the energy generated by Andrew preventing its further growth.

On August 20, tropical storm Andrew had weakened considerably, with diminishing winds and increasing central pressure. If this trend had continued, Andrew would have soon weakened below a tropical storm level and then disappeared into the general circulation of the tropical Atlantic atmosphere.

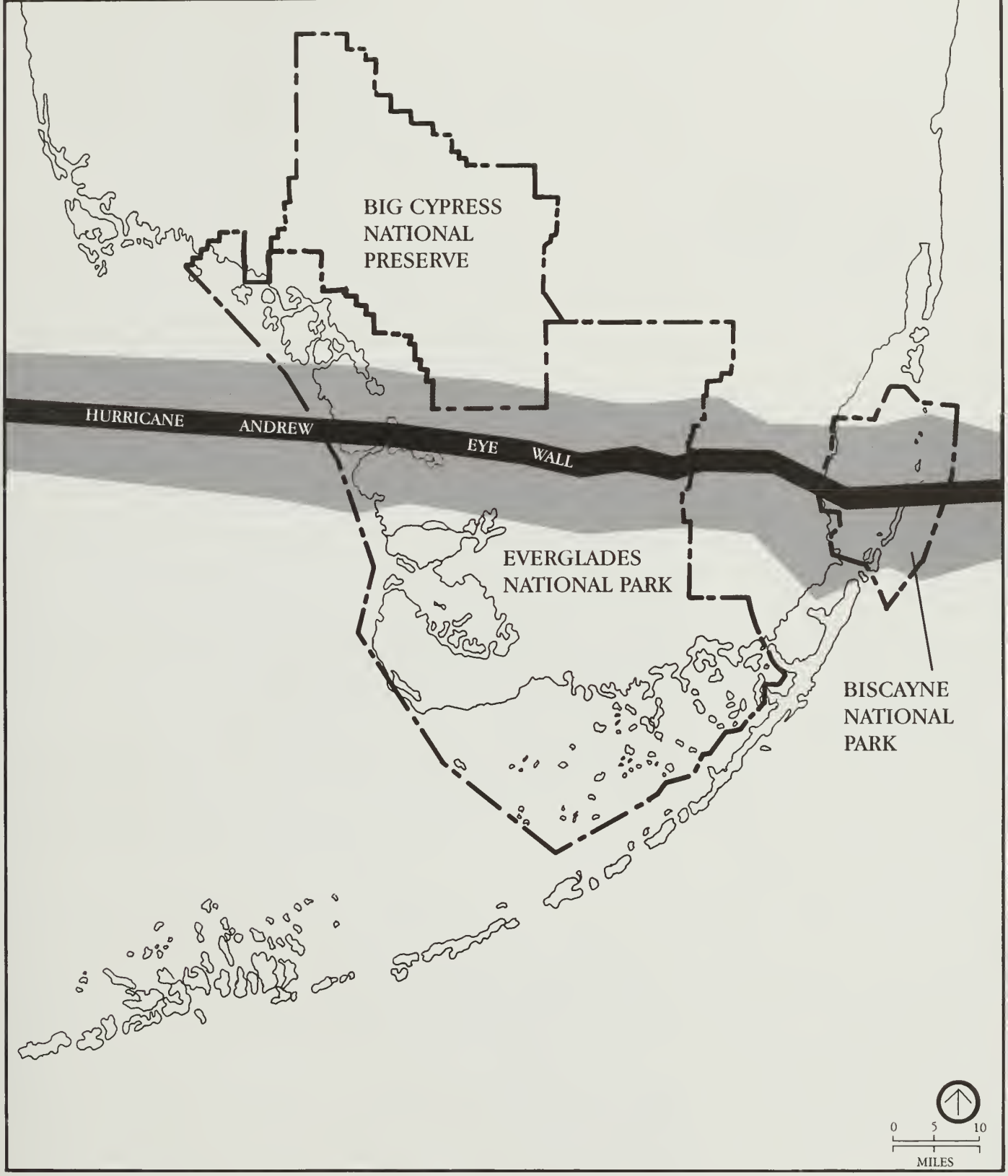
On August 21, the large-scale circulation in the vicinity of Andrew changed dramatically. The low-pressure system that had previously been sapping Andrew's strength weakened and split. A portion of the low moved to the southwest of Andrew. A strong high-pressure system developed to the northwest. The combination of counterclockwise flow from the low and clockwise flow from the high propelled Andrew west and provided ideal conditions for tropical storm growth.

At 2000 on August 21, Andrew was classified as a hurricane. Andrew continued to grow. By the afternoon of August 23, Andrew had grown into a borderline category 4-5 hurricane. Central pressure dropped to a low of 922 millibars.

On August 23 and 24, Andrew made landfall over the Bahamas. The eye of the hurricane passed over northern Eleuthera Island late on August 23 and over Berry Island early on August 24. The hurricane continued almost due west. Andrew intensified as it crossed the Straits of Florida.

On August 24 at about 0500, the eye of Hurricane Andrew crossed directly over Elliott Key and the hurricane made landfall directly over the Convoy Point visitor center in Biscayne National Park (Figure 3). The central pressure at the time of landfall is estimated to have been 926 millibars. In this century, in the United States, only Camille in 1969 and the Labor Day (Keys) Storm in 1935 had lower pressures at the time of landfall. Sustained winds at the time of landfall were estimated to have been 145 mph, with wind gusts of over 160 mph.

The storm hit near the time of high tide, producing a large but local storm surge in the coastal portion of southeastern Dade County. The storm surge overtopped coastal water control structures and levees in the storm path. Storm surges of up to 16.9 feet were measured in the northern portions of Biscayne, with 7 feet reported in the southern portion of the park.



Big Cypress National Preserve • Biscayne National Park • Everglades National Park
U.S. Department of the Interior • National Park Service
160/169/176 • 20051 • DSC • 8/94

Figure 3. The Track of Hurricane Andrew through South Florida.

Hurricane Andrew was a relatively compact, fast-moving storm. The swath of maximum wind damage was approximately 30 miles wide. Rainfall of up to 7.79 inches was recorded, although rainfall amounts of around 2.00 inches were more common during the passage of the hurricane through south Florida.

The hurricane continued west, traveling at a speed of about 18 mph. Four hours after landfall, Andrew departed from the west coast of Everglades National Park, with a central pressure of about 950 millibars. The hurricane had weakened somewhat during its passage over land, but the storm remained a major hurricane (category 3).

Hurricane Andrew traveled west-northwest across the Gulf of Mexico. The high-pressure system that had steered and sustained the storm during the prior few days now dissipated, and the hurricane slowed and drifted to the northwest.

On August 26 at 0430, Andrew made its final landfall on a sparsely populated section of the Louisiana coast, about 23 miles west-southwest of Morgan City. The hurricane maintained a category 3 strength at the time of its landfall in Louisiana.

Although damage from wind and storm surge was lighter in Louisiana, rainfall from Hurricane Andrew was heavier. Nearly 12 inches of rain fell at some locations. The hurricane spawned numerous tornados in Louisiana and adjacent states.

Hurricane Andrew quickly dissipated as it moved inland from the Louisiana coast. Ten hours after making landfall in Louisiana, Andrew was downgraded to a tropical storm. Two hours later, Andrew ceased to be a tropical storm.

The remnants of Hurricane Andrew continued to produce heavy rains as the storm moved northeasterly. The storm eventually joined a frontal system over the mid-Atlantic states on August 28.



Incident Command System

To effectively manage any type of special event or incident, some sort of organizational structure is needed. The Incident Command System, a component of the National Interagency Incident Management System, is widely recognized among the federal land management agencies and most federal, state, and local fire and emergency service organizations as the organizational structure of choice for managing emergency operations of all types.

Originally developed to manage large, complex wildland fires, the Incident Command System is an organizational structure with predefined positions, responsibilities, and working relationships that are designed to allow a rapid and effective activation of an incident management organization. The system is designed to be flexible. Only those positions that are needed to manage a particular incident are filled. As an incident increases or diminishes in size or complexity, individual positions within the organizational structure are filled, and then demobilized, as needed. With one predetermined organizational structure in place and with standard training and qualifications, individuals from many different organizations can come together and become an effective working team quickly.

Incident Management Team

Throughout the United States, incident management teams are preestablished for wildland fires. These teams are categorized by type: Type I teams handle the largest and most complex fires; Type II teams handle smaller wildland fire incidents or those of lesser complexity.

Although the Incident Command System was originally designed to be an "all-risk" system to handle incidents of all types (such as fires, earthquakes, floods, oil spills, dignitary visits, special events, hurricanes, and more), the system has received little use outside the fire and emergency services arena—except in the National Park Service. In 1985, when the Incident Command System became the standard organiza-

tional structure for managing wildland fires, the National Park Service mandated that the Incident Command System would become the standard organizational structure for managing all incidents servicewide. Most national parks use the Incident Command System for managing every type and size of incident, from a small motor vehicle accident in which an incident commander, a medical response team, and an investigator may be the only staff, to very large incidents in which a full overhead team manages hundreds or thousands of personnel in the field.

That the National Park Service has quickly applied the Incident Command System to a wide variety of uses is not surprising, given the agency's history. Since the agency's inception in 1916, NPS employees have been routinely involved in a variety of public and emergency service work: law enforcement, emergency medical services, search and rescue, structural and wildland firefighting, dignitary visits, special events, and more. Few other federal agencies have as much experience managing incidents of all types, or the diversity of emergency service skills nationwide.

Using the Incident Command System within the National Park Service is not limited to those incidents that originate within the parks. With over 365 parks nationwide, the National Park Service is almost always affected by the impacts of major natural events, many of which originate outside park boundaries. In just the last few years, almost every major natural event that has received media attention (Hurricane Iniki, Hurricane Hugo, Mount Redoubt volcano, the Greater Yellowstone Area fires, the Lomo Prieta earthquake in San Francisco) and many other more minor events have affected parks.

Not all incidents where the Incident Command System has been used have been natural events. The Dan Horning manhunt in Grand Canyon, the Exxon *Valdez* oil spill, the search and rescue of an injured caver in Lechiguilla Cave, the visit of Queen Elizabeth II to Yosemite, numerous presidential visits to park areas, the 50th anniversary of Pearl Harbor, and the hostage taking of a park visitor in Yellowstone are examples. In almost every case, the National Park Service used the Incident Command System to manage these events.

In 1991, recognizing that the Incident Command System had become widely accepted throughout the National Park Service, and that the established incident management teams remained focused primarily on managing wildland fires, the National Park Service established its own Type I Incident Management Team. The key command and general staff positions were filled, and the team was made available for dispatch nationwide. The first incident the Type I team managed was the 50th anniversary of Pearl Harbor. Managing the Hurricane Andrew recovery of the three national parks in south Florida was the team's second assignment, and its first major emergency response operation.

Although the south Florida national parks had gone into an incident command function before the storm arrived, the parks recognized that the scope of the impacts and the job that lay ahead were far beyond the capability of even a large and experienced park staff. Many employees were devastated; almost all were affected to some degree. Over one-third of the work force lost their homes. There was no electricity, no phones, limited radio communications, no water, and no sewer. Travel was almost impossible. The task of accounting for the park employees, attending to their immediate personal needs, securing the parks, assessing the damages, stabilizing structures, and even beginning the rebuilding process was clearly beyond the capability of the park staff, or even an organized Type II incident management team.

Incident Command System and Hurricane Andrew

With the advent of the hurricane, each park implemented its hurricane plan, which included designating a park incident commander to direct the preparations. The parks operated under this system using their own personnel, until the Type I Incident Management Team was in place and the delegation of authority was signed.

For example, on August 22, the Everglades superintendent implemented its hurricane plan, placed the park under the Incident Command System, and identified a park incident commander. The August 25 operations plan for Everglades identified the incident objectives for that day: secure Flamingo, open roads to the Daniel Beard center and Flamingo, assess damages at that center and fire cache, keep water on-line, schedule for gas and electricity at Pine Island, evaluate fuel situation, and document damages. Recognizing the tenuous situation in south Florida for medical assistance, priority number one for the incident that day was safety. Most primary incident command positions were filled, all available park employees were assigned positions within the team, and the Everglades incident management team worked towards their objectives.

An early task of the park team was to request the assistance of the Type I Incident Management Team. The Type I team was activated on August 25 and arrived in Fort Myers, Florida, early in the morning of August 26. By 0930 on August 26, the team was on-scene at Everglades headquarters. After the team was briefed on the situation, a joint delegation of authority was prepared and signed by the three superintendents at 1100. The delegation provided the Type I Incident Management Team the authority to deal with the disaster in all three parks and outlined the superintendents' objectives. Based on this delegation, the Incident Management Team developed the objectives for the Hurricane Andrew incident and recovery.

Hurricane Andrew Incident and Recovery Objectives

1. Provide for basic emergency needs of employees and families of Big Cypress National Preserve, Biscayne National Park, and Everglades National Park.

2. Provide for employee safety.

3. Prevent further damage to resources, property, and facilities.

4. Secure, protect, and salvage all facilities.

5. Rehabilitate facilities to permit normal use.

6. Assess the restoration and rebuilding needs for structures and facilities, including the requirements for supplies, materials, and equipment.

7. Prepare a factual account of the Hurricane Andrew incident as it pertains to the parks in south Florida from documents and interviews.

Initially five people traveled to Florida, representing the following positions: incident commander, operations section chief, planning section chief, logistics section chief, and finance section chief. The information officer that normally travels with the Incident Management Team was on the Everglades staff; another information officer was ordered and on-duty August 29. Existing staff from the three parks filled a number of ICS positions, such as unit leaders, and additional personnel were ordered and arrived during the first week after the hurricane. The incident's organization as of September 18, near the height of personnel commitment, is shown on Figure 4.

By August 31, three branches were created within operations to deal with the geographically separate areas. Branch I had operational responsibility for the eastern areas, primarily Biscayne National Park, along with Everglades National Park resources in the Florida Keys. Branch II spanned the center of Everglades National Park, including East Everglades and the headquarters area to Flamingo. Branch III included the northwestern quadrant of Everglades National Park, from Shark Valley west, and Big Cypress National Preserve (Figure 5). In addition, a separate air operations branch managed rotary and fixed-wing aircraft.

Each branch included three to four groups that handled the various tasks assigned to the branch. For example, all three had a security group to ensure that the park closures were effective and to maintain protection of personnel, equipment, and resources. Each branch also had a facilities rehabilitation group that was responsible for cleanup and repairs.

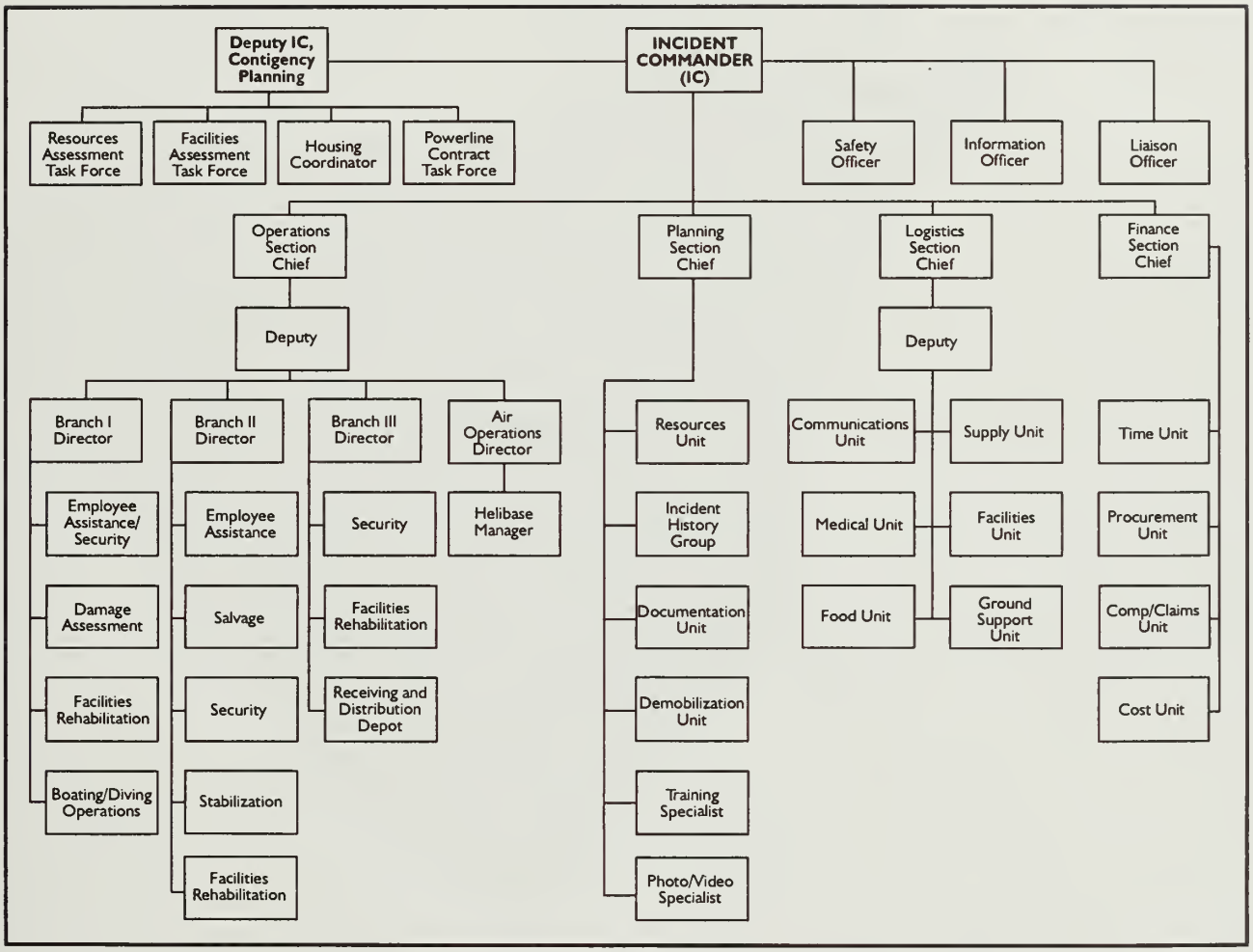
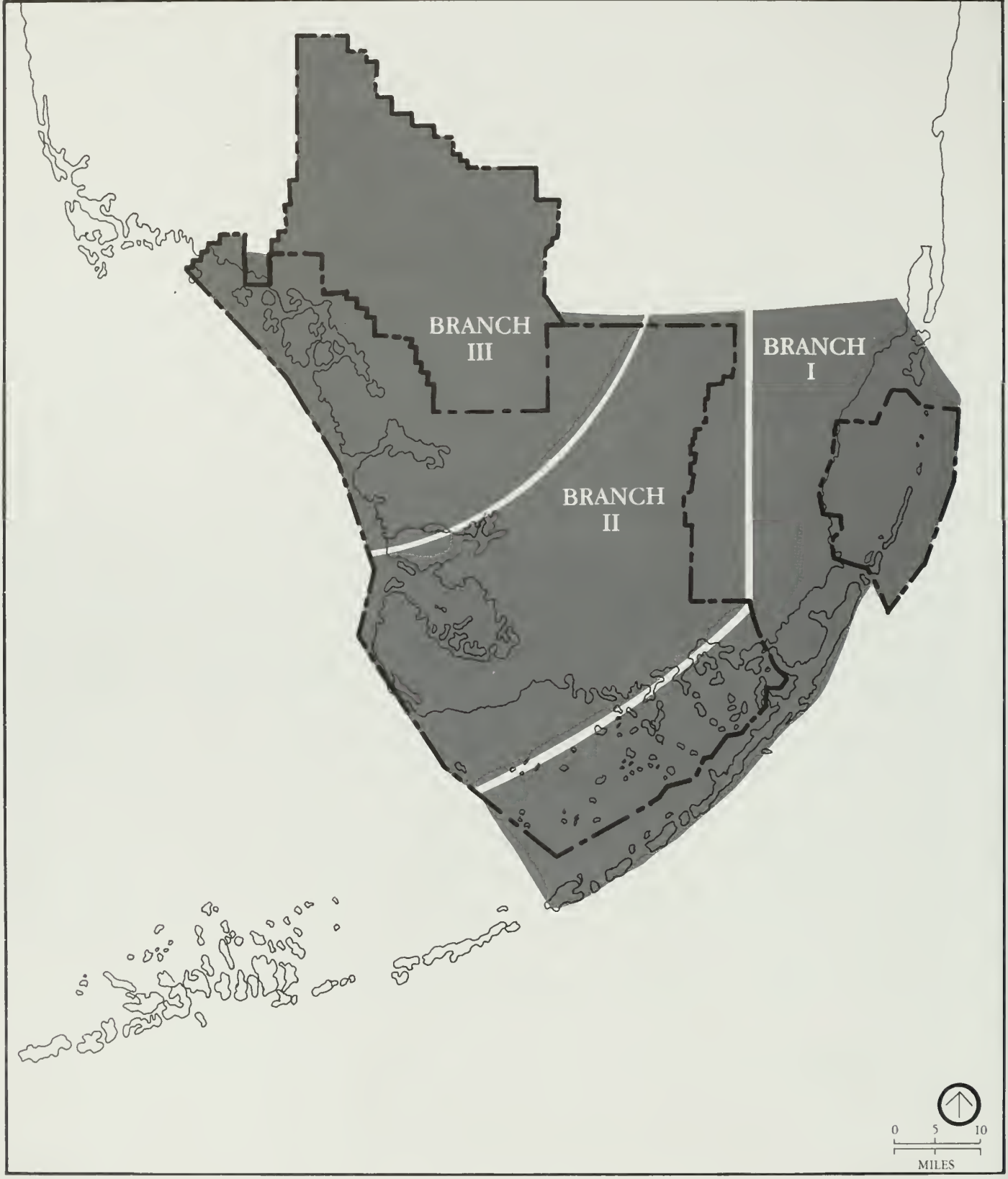


Figure 4. Hurricane Andrew Incident Command Organizational Chart



Big Cypress National Preserve • Biscayne National Park • Everglades National Park
U.S. Department of the Interior • National Park Service
160/169/176 • 20052 • DSC • 8/94

Figure 5. Branch Boundaries for Hurricane Andrew Incident

Technical specialists were assigned to handle a variety of specific functions. The superintendent of Fort Sumter National Monument, who had experienced Hurricane Hugo, was brought in as deputy incident commander for contingency planning. A training specialist coordinated training and training assignments for individuals. The Incident Management Team recognized that the recovery efforts of Hurricane Andrew would provide many people who qualified as incident trainees an opportunity for on-the-job experience. The need for a factual account of the incident was recognized, and an incident history unit was ordered. A resource specialist advised the team on natural resource management issues and assisted with the handling of the logistics for the resource assessment task force. A photo specialist provided visual documentation of the storm's aftermath.

The standard tour of duty for most individuals assigned to an incident is 21 days, some stay longer. As they approach the end of that time period, the individuals are demobilized and returned to their home unit. Replacements are ordered 4 to 5 days before the incumbent demobilizes to allow for a 1 to 2 day overlap and to ensure a smooth transition. With Hurricane Andrew, individuals began rotating off the incident beginning the week of September 14. Many were replaced, but as the need for positions lessened, the number of people assigned to the incident slowly shrank.

Many south Florida park staff were also assigned to the incident. In the initial days after Hurricane Andrew, virtually all park staff who were on duty were assigned to incident functions and worked towards the incident objectives, not to their regular park jobs. As the Incident Management Team ordered more resources, and the lives of park employees stabilized a bit, park staff individually returned to their regular positions.

The Incident Command System is flexible, growing and shrinking as the needs of the incident dictate (Figure 6). As of October 10, 593 individuals from 98 national parks, 16 national forests, and several other organizations had been assigned to the incident. As the overall incident lessened in scope and more of the routine operations were returned to the park, the need for the Type I Incident Management Team also lessened. Planning for a transition to a Type II incident organization began in late September, and by October 8 a new incident commander and key general staff transitioned to assume management of the incident.

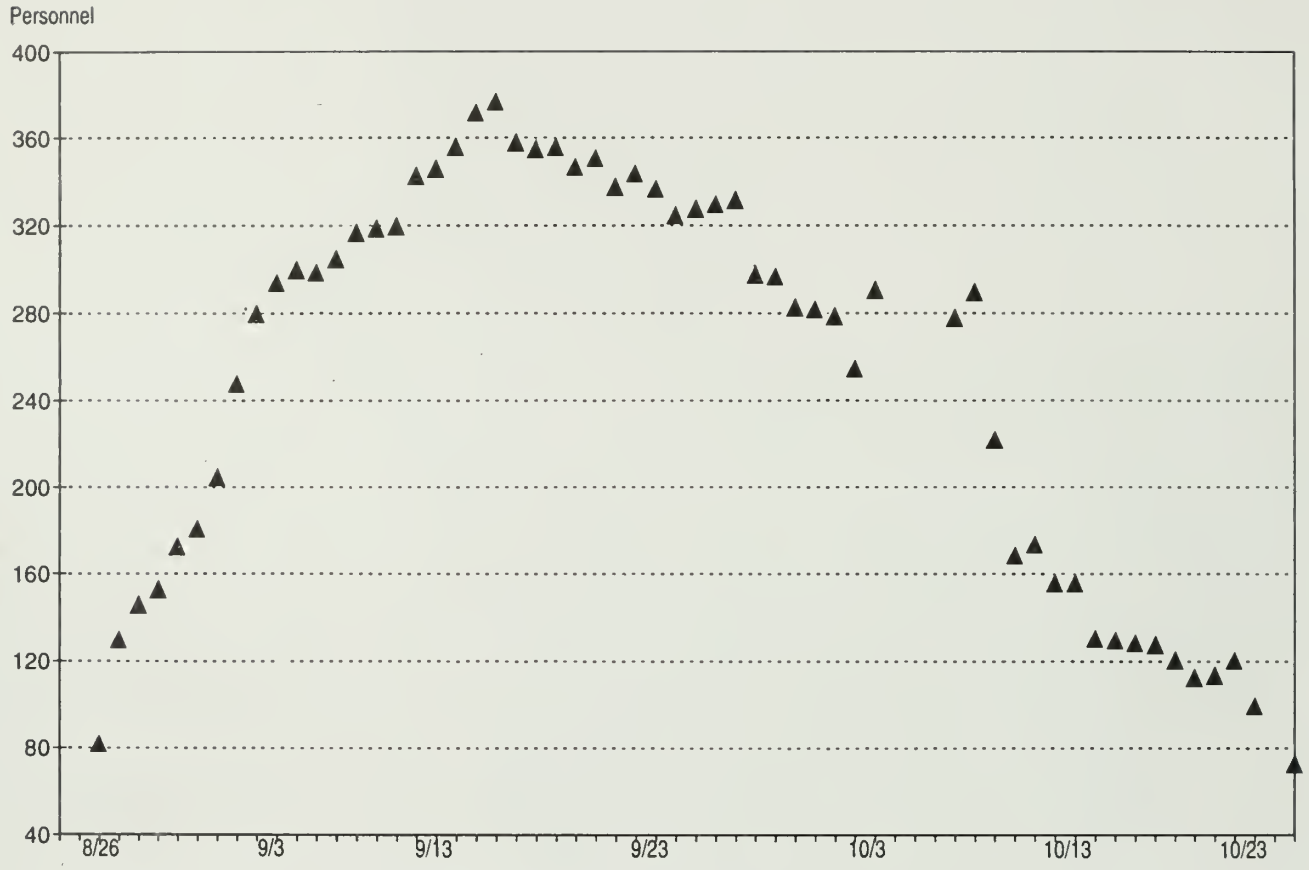


Figure 6. Number of Personnel on the Hurricane Andrew Incident

Incident Command Functions

INFORMATION

Although Hurricane Andrew was of immeasurable interest to the public at the local, regional, and national levels, little media attention was focused at first on the national parks in south Florida. The parks were inaccessible due to downed trees and powerlines, and the media was concentrating on the devastation and human-interest stories in Homestead and Florida City.

Once the media interest started, cooperation from the media was good. Media representatives were escorted to sites, such as Convoy Point at Biscayne, by park staff. CNN was the first national media to arrive on Saturday, August 29. Numerous other film crews from Miami, Orlando, Fort Myers, Jacksonville, and Fort Lauderdale also toured the area. On September 6, an ABC news crew came to Everglades to compile material for a story on the effects of Hurricane Andrew on the ecosystems of the parks.

One of the first articles to come out, after the hurricane, concerned the Florida panther. Newspapers that published articles on the effects of the hurricane on the south Florida national parks included the *Miami Herald, New York Times, Boston Globe, Knoxville News-Sentinel, Atlanta Journal, Detroit Free Press, United Press International*, and the *Associated Press*. *National Geographic* planned to do a story on the hurricane damage to the resources for a spring 1993 issue.



The information function for the parks began on Thursday, August 27, at Everglades headquarters, the incident command post. Initially, to get information to and from the other park areas, messengers and park radios were used. Later, as telephones, telefaxes, and word processors became available, the task of communicating became easier.

The first media release was issued on August 28 from the Southeast Regional Office on the closure of Biscayne and Everglades due to hurricane damage. On September 1, the Washington Office public affairs officer issued a news release regarding the closure of Everglades and Biscayne for an indefinite period of time. On September 5, the information officer issued a news release on the continuing closures of the national parks in south Florida. Other national parks issued news releases in regards to their assistance in the hurricane recovery effort.

Special efforts were made to inform the park communities. Particularly effective was the South Florida Parks Courier, "The Swamp Rag." This newsletter was issued on a daily basis to Flamingo, Pine Island, Convoy Point, and Big Cypress personnel. The employee assistance teams took copies with them when they went outside the parks to talk with the other employees and their families.

Other forms of communications were as follows:

- All-employee meetings were held at Everglades on September 16 and at Biscayne on September 17.
- Incident personnel organized the legal professionals and the employee claims representative to attend two meetings that were held on the afternoon of September 3 at Everglades and Biscayne. A meeting was conducted the following week at Big Cypress. The claims representation was also stationed at Pine Island for a week to provide assistance.
- A handout on potable water for emergency use, food supplies under emergency conditions, and general sanitation in emergency conditions was written and distributed. Copies were kept on counters at park headquarters.
- The Eastern National Parks and Monuments Association initiated the Hurricane Andrew Relief Fund to provide assistance to park employees and their families. A handout on the procedures for applying for the funds was distributed at the all-employee meetings.
- A publication listing where to find help was widely distributed. The handout covered check-cashing, counseling, price gouging, food, insurance, mail, and availability of ice and water. A Miami newspaper had printed this list, and the parks had copies made for employees.



- Park rangers were stationed at the entrance to Everglades and Biscayne to provide information on the park closures to visitors and to ensure that only authorized vehicles entered. Signs were placed along roads approaching the parks notifying visitors that the parks were closed.

SAFETY

The safety officer's function on an incident is to assess hazardous and unsafe situations and develop measures for ensuring personnel safety. The large-scale damage from Hurricane Andrew and the environmental and work hazards, combined with reduced emergency medical system capabilities, made the job particularly challenging.

The south Florida environment is deceptively hazardous to the uninformed. The high temperatures and high humidity increase fatigue and can lead to heat exhaustion. Poisonous plants are frequently encountered. The presence of poisonous snakes and insects requires constant vigilance. The horizontal landscape with its cover of thick vegetation and water hides areas of irregular footing.

The debris from Hurricane Andrew added new hazards to the environment. Uprooted trees, partially broken limbs, downed powerlines, unstable buildings, building debris, and severely stressed coworkers required increased caution.

The safety officer assessed these hazards and worked with the Incident Management Team to develop safe working methods. A large part of this effort focused on educating workers about the hazards and providing information on safe working practices.

TRAINING

Training objectives for the incident were threefold:

1. Identify and process trainees already assigned to the incident.
2. Identify opportunities for ordering and placing additional trainees from the NPS Incident Overhead Personnel Development Program list.
3. Test the National Wildfire Coordinating Group draft position task books, as to the accuracy and completeness of the tasks, the application to nonwildfire incidents ("all risk" use of task books), and the integrity of the task book process and acceptance by trainees and trainers.

The Incident Management Team established a training unit on September 13. The unit began locating trainees and advised incident and park personnel of the availability of a documented training program. By September 19, approximately 25 trainees were enrolled, provided task books, assigned trainers, and briefed about the process. The training unit coordinated with the Washington Office, Branch of Fire and Aviation Management, to obtain fully qualified trainees from the NPS Incident Overhead Personnel Development Program list and placed name request orders for additional trainees in nonoperations functions.

The unit's role of locating willing trainers, placing trainees, processing task books, performing status checks, and closing out records, with accompanying overhead performance ratings and task book evaluations at the end of training assignments, continued through October 3. A total of 95 trainees were processed from all three branches, with letters of recommendation and copies of performance ratings provided to home unit agency administrators. Of the 95 trainees, 30 were verified as meeting full qualification standards, with recommendation for home unit-agency position certification.

LOGISTICS

The logistics section was responsible for providing all of the support needs of the incident. Initially, basic park systems were destroyed, damaged, or inaccessible, making logistical operations difficult. Overcoming these difficulties, the section provided facilities, transportation, supplies, maintenance and fueling equipment, food services, communications, and medical services.



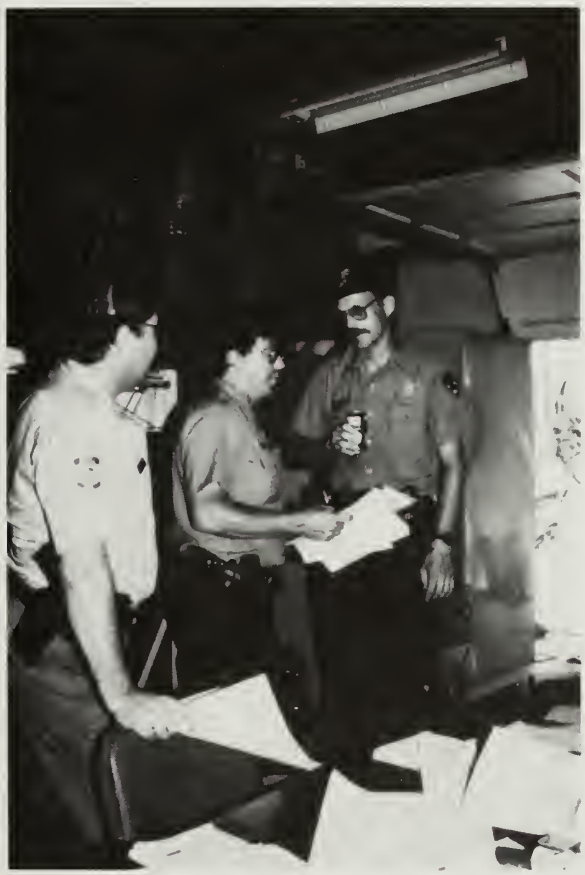
The Incident Management Team determined early on that a supply staging and distribution center needed to be established. The Oasis visitor center at Big Cypress was determined to be an adequate facility. A 120-foot by 24-foot storage structure was constructed behind Oasis to handle the large shipments of building materials. An NPS maintenance task force was ordered in to construct this structure. In two weeks, they had the facility roofed and wired for electricity. Over $1,000,000 of supplies and materials were received and distributed through this supply center.

The logistics section also ordered vehicles and equipment to support the maintenance task force and fire crews. Over 324 passenger vehicles and small trucks were used to support the emergency operations and overhead team. A total of 541 pieces of equipment were delivered to the project in the first four weeks of the incident.

In the days immediately following the hurricane, food was limited to rations and anything else that could be obtained from personal supplies. By August 28, the Florida Division of Forestry operated a field kitchen, which was staffed by 13 Job Corps members. The kitchen fed about 150 people for breakfast, lunch, and dinner until the evening of September 14. Over the Labor Day weekend, the Flamingo lodge also started food service operations. At the peak in late September, the lodge fed 300 individuals for dinner, up to 400 lunches, and 250 breakfasts. Lunches were provided to incident personnel and park staff through October 9. Beginning on October 12, food service was limited to incident personnel and individuals living at the Flamingo lodge.



Incident Management Challenges and Innovations



Damage from Hurricane Andrew was most severe in Biscayne National Park and parts of Everglades National Park. Flamingo, in the southern portion of Everglades, and Big Cypress National Preserve were damaged, but to a much lesser extent. The heavily populated communities of Cutler Ridge, Florida City, and Homestead were severely damaged.

Park employees were isolated in Everglades and the nearby communities. Most roads were inaccessible due to downed trees, powerlines, and debris. Lack of power was a critical problem. Overhead lines were downed throughout south Dade County. Communications with the outside world were limited. The nearby communities were in chaos; the team could not rely on any local infrastructure for assistance. The governor of Florida declared martial law, called out the National Guard, and established a curfew for south Dade County. Housing was a serious challenge. Adequate lodging and food services were needed for displaced employees and their families and incident personnel.

Faced with these challenges, the parks and Type I team developed innovative solutions. This section highlights those challenges and solutions.

Humans vs. Hurricane Andrew

By nightfall on August 23, all park employees from Big Cypress, Biscayne, and Everglades that lived in government housing were at designated shelters. Each person had been instructed to bring sleeping accommodations, equipment, and food to last at least 24 hours.

Key Largo and East Everglades employees had evacuated to designated shelters at Pine Island in Everglades. Everglades employees, with residences outside the park, were ordered to go home, and employees residing in Flamingo to evacuate to Pine Island.

Everglades City and Gulf Coast employees had evacuated to the Oasis visitor center in Big Cypress National Preserve. Big Cypress had minimal staff at designated sites, with the remainder of employees sent home.

Biscayne employees were released in midafternoon on Sunday, August 23, to return to their private residences. Employees in government housing on the Keys had evacuated to the mainland and sought shelter at a designated site, the Homestead Holiday Inn. This Holiday Inn, however, was also in an evacuation zone, and the six employees from Biscayne radioed for permission to evacuate to Pine Island in Everglades. Three of those employees later obtained shelter on their own with friends in Homestead.

When reports were received that the winds of the storm exceeded 150 mph, the park incident management team, by radio and in person, explained to employees in the Pine Island residences the need to evacuate to one of three safer locations: the dispatch wing at park headquarters, the Pine Island ranger offices, or the Pine Island supply building. This additional evacuation was not mandatory, and although most employees moved to one of the three designated areas, approximately 15 employees

stayed in the residences at Pine Island, primarily due to concern over abandoning their pets.

Other employees were in their homes in the Florida City/Homestead area or in communities farther north of the parks.

As the storm tore across south Florida on Monday, August 24, the terror that people felt was indescribable. Evacuated employees in the Everglades headquarters tell of watching the storm through one small wire-reinforced window and observing huge trees flying by, parallel to the ground. Storm shutters on the windows failed, sheets of water flowed through the tops and bottoms of doors, and in some offices, ceilings collapsed. Employees living in Homestead experienced the eye; those at Pine Island in Everglades National Park did not.



At daybreak, employees at Everglades ventured out to observe the wreckage surrounding their areas. In pairs, employees surveyed the road on foot, from the Pine Island maintenance area through the residential area. Two rangers, in a four-wheel-drive vehicle, negotiated the debris-strewn road from headquarters to the L-31 canal on the east boundary of the park; other rangers surveyed the road to Flamingo.

The scope of the catastrophe was overwhelming. Small victories against Andrew became the only bright spots for many days to come. Soon after Andrew had passed through Pine Island, the Biscayne chief ranger waded through water and debris to a trailer where his clerk had left her beloved companion, her cat, DC. Searching throughout the badly damaged trailer, the chief ranger had about given up hope of finding the cat when he spotted it cringing in fear under a bed. Rescuing the cat brought a cheer and many tears from the still stunned employees.

Extremely heavy rains and wind again pelted the area, and the employees were forced to remain in their shelters.

Later, the Biscayne chief ranger, with his clerk following in a second vehicle, left Pine Island and headed to Homestead to check on their homes and the park. This 25-mile distance took over 3 hours as they negotiated countless road hazards and the devastation left by Andrew. They were not able to get into the Convoy Point area until Tuesday, August 25; the road was impassable. The clerk's mobile home was totally destroyed, and she sought shelter for several days at the heavily damaged Biscayne chief ranger's residence.



The only knowledge of how hard the storm had hit came from radio transmissions that were sent from personnel with park radios in the local communities. Because the radio batteries could not be recharged, these transmissions were brief. Commercial radio provided scanty reports, with the most accurate and up-to-date reporting found on television. Everglades rangers plugged the only TV into the computer battery backups, giving them approximately 10 minutes of news before they had to plug into another computer.

Hazardous conditions existed, both in and outside the park, especially during the first 72 hours after the storm. Downed utility lines, falling trees and structures, flooding, damaged vehicles, and a general sense of citizen unrest and upheaval pervaded all of the areas in the path of the hurricane.

Big Cypress sustained some damage, but nothing on the order of magnitude of their friends and neighbors to the south and east. They heard only broken portions of radio transmissions describing the damages in Homestead and Pine Island.

One Big Cypress ranger, after working on emergency repairs in Everglades City and returning to his home in Naples that night, said he did not realize the magnitude of damage until he saw Dan Rather standing on a freeway overpass in Homestead. He started to cry when he saw the destruction and thought of his friends. Shortly after the news broadcast, his telephone began ringing. An Everglades employee called from Orlando asking about his home. The Everglades employees, who were fighting a fire in Idaho, called asking for information about their families and homes. All he could do was promise to gather information and counseled them to prepare for the worst and hope for the best.

Big Cypress staff conducted the first overflight of the damaged areas of Everglades and Big Cypress on Tuesday morning, August 25. Soon after preserve staff returned to Oasis, the description of the damages was passed on to NPS employees throughout the country.

Normally, park staff from the three parks would have been able to respond to any emergency, but they were effectively immobilized by the widespread destruction of the hurricane. Normal utility systems were inoperable. There was no electricity, no phones, limited radio communications, no water, and no sewer. Employees needed to be contacted. Their situations needed to be assessed, and emergency and long-term assistance given. The NPS director, touring the parks after the storm, emphasized that:

> *we are looking at this as a major incident in the context of the National Park System. And we are committed to provide whatever support is necessary . . . whether it be housing or people, or whatever . . . and to channel it to you in ways which are useful to you, both professionally in the workplace and personally as families.*

Employee Assistance Programs

EMPLOYEE ASSISTANCE TEAMS

Within 24 hours after the storm, employee assistance teams were established to contact all employees, in government housing as well as private housing in the Florida City/Homestead area or communities farther north, and to determine their status and immediate needs. These teams consisted of two or three park employees, with at least one law enforcement ranger. Because the phone lines were down and no other effective means of communication existed, these teams had to contact each employee in person.

Within 36 hours, the employee assistance teams went into the communities with survival supplies to distribute to employees. These supplies included drinking water, ice, food, and minimal roofing and covering materials.

As the first teams left the parks and began heading into the communities, the devastation they encountered brought a sense of fear that they would be discovering fatalities or serious injuries among their fellow employees. This stressful aspect of their assignment was repeatedly mentioned by the initial responders.



Travel to the homes was hazardous, frustrating, and extremely time-consuming. The normal landmarks of street signs, house numbers, and stoplights had been destroyed.

Frightened, stunned citizens were driving damaged vehicles with flat tires, body damage, smashed windshields, and overloaded cargo.

As part of each park hurricane plan, all employees had to submit emergency contact information sheets that listed home addresses and phone numbers. The teams had difficulty in trying to locate employees using the contact sheets. Some employees had never submitted the form, or submitted old addresses, or listed post office boxes instead of street addresses.

Fortunately, payroll had been submitted 36 hours before the storm, and this list was used to update the employee roster. Within the first few days, omissions caused additional problems as the current employee roster did not list such personnel as contract researchers, VIPs, natural history association employees, concessioners, and NPS retirees still in the area.

During the first week, the employee roster system was refined, and updated information was entered into a computer database. By the end of the first week, all Big Cypress, Biscayne, and Everglades employees and their families had been contacted. This database proved to be invaluable as pertinent employee welfare information was added, such as condition of residence, number of people in a residence, physical needs, monetary needs, medical problems, food and water needs, contact person, and date expected back to work.



The surrounding communities were in chaos, with looting and general unrest present. The teams went into the communities with full law enforcement equipment and in marked patrol units. Their law enforcement presence in the disrupted areas resulted in several calls for assistance from distressed citizens being victimized by ongoing crimes. For example, a citizen requested assistance from a team of three law enforcement rangers in the Cutler Ridge area on Wednesday, August 26. A frantic female flagged

down the rangers. She screamed that a nearby group was brandishing weapons. As the team radioed back to the park requesting local law enforcement backup, they came upon an unruly group of 15 to 20 adults arguing and displaying weapons. The team exited their vehicle with a shotgun and their handguns; the Florida Highway Patrol arrived on-scene and jointly controlled the crowd with the NPS rangers.

Other situations occurred during the first two weeks, including citizen requests for law enforcement response to burglary in-progress, looting, and medical aid. The presence of many different law enforcement agencies throughout the area led citizens to expect that NPS rangers had enforcement jurisdiction in the community.

The employee assistance teams were also frequently surrounded by other people in the community requesting minimal survival supplies. The teams assisted those victims in serious distress with some food and water and gave them information on the location of humanitarian aid stations that were being established throughout the communities.

With the arrival of incident personnel and supplies after the Type I Incident Management Team was activated, the employee assistance teams were able to provide more assistance to employees, such as patching roofs, packing up and moving property to storage, photographing and inventorying damaged property, clearing debris, distributing and setting up generators, and providing emergency vehicle repairs. They salvaged and stored household furnishings for 43 families; delivered over 3,000 pounds of ice and 80 generators; provided 400 sheets of plywood, 300 rolls of felt roofing paper, numerous camp stoves, 1 ton of food, 80 rolls of plastic sheeting; and helped stabilize 57 homes.



Within two weeks, the teams made over 600 contacts. When the satellite phone system was installed, the team established an 800 number for an employee hot line.

For many devastated employees, the arrival of the employee assistance teams, and later the CISD team, provided the only link to the park and their colleagues.

CRITICAL INCIDENT STRESS DEBRIEFING PROGRAM

Recognizing that the destruction from Hurricane Andrew could create severe emotional stress on both the victims and the rescuers, the Type I Incident Management Team activated the CISD team to assist employees and their families. The first three NPS peer supporters arrived within 72 hours after the storm, with two mental health professionals arriving on Saturday, August 29.

This program assisted people with understanding, recognizing, and coping with their stresses. Studies have proven that people exposed to traumatic events and given the subsequent benefits of CISD services return to work sooner and with fewer long-term stress reactions.

Although the CISD concept has been present in emergency services for at least 15 years, it was the first time that the National Park Service used this technique for a long-term disaster response.

Due to the difficult logistics of trying to contact all of the employees, both assigned to the incident and those not able to leave their homes, the CISD team worked closely with the employee assistance teams to develop priorities.

The CISD team traveled to all of the park areas, contacted over 300 NPS employees, VIPs, and retirees, and provided one-on-one peer support sessions called defusings. The CISD team also conducted 15 group debriefings, which were generally organized by work units in the parks.

The emotional impact of the disaster on all employees was quickly evident to this team. Those who had lost their homes were in shock—overwhelmed by the loss of property, angry at being a victim, afraid of financial ruin and homelessness, and concerned about their children and spouses and the uncertainty of the future.

Those employees who had not suffered significant losses were showing signs of grief for the losses of their friends and colleagues, guilt that they had been spared while others were devastated, afraid for their safety because of looting and other criminal activity, and depressed over the overwhelming amount of destruction.

Each person had an individual and personal story of how he or she had survived the disaster. A recurring theme emerged, of riding out the storm with family and friends, running in fear from room to room, glass shattering around them, roofs ripping open

as they finally huddled together hugging pets, strangers, and loved ones in closets, kitchen cabinets, or under furniture hoping that they would survive. Numerous employees told the peer supporters and mental health professionals that they thought they were going to die.

The CISD team provided grief counseling for coworkers and friends of the deceased employee from Fort Jefferson and assisted the family in arranging for the funeral and burial, including the medical and emotional assistance in bringing his injured son from the hospital to attend the funeral.

The team also provided family counseling for those venting stress through physical and emotional abuse on their families.

The CISD team also conducted on-scene peer support for emergency workers that were under extreme physical and mental stresses caused by the continual immersion in the event, attempting to aid others in an ongoing tragedy while being victims themselves.

The CISD team provided a stress-recognition seminar for supervisors, and plans were implemented for future stress education training for all park employees. Long-term plans to alleviate employee stress reactions included the contracting of a special mental health professional for the next two years. This professional counselor will provide personal services on a no-charge basis to employees and their families.

The team was often overwhelmed by the sheer number of those to be counseled and the severity of unrelieved stress that some employees exhibited. The Incident Management Team intentionally mobilized only NPS peer supporters, although civilian peer supporters may also have been available. Employees expressed appreciation that the peer supporters were fellow NPS employees. One employee found by a combination employee assistance and stress debriefing team in her destroyed home tearfully exclaimed, "I have never been so happy as when I saw those green and gray uniforms come walking up my driveway."

OTHER PROGRAMS

Monetary Assistance. The Eastern National Parks and Monuments Association established a monetary donation account. Donations came from other cooperating associations, concessioners, fellow NPS employees and families, and others wanting to help their park friends. This fund provided cash donations to employees and their families. All employees could apply for a basic $200 donation from this fund anytime over a six-month period. This fund was also used to cash personal checks.

Funds from this donation account also assisted the Rohena family with funeral expenses, and paid for an employee's flight to enable him to be with his wife who had evacuated for the birth of their first child.

The Hurricane Andrew Relief Fund steadily grew to $100,000 by the end of the first month after the storm.

Leave Policies. Those who were not able to immediately return to work because of personal emergencies were placed on administrative leave. NPS management, from the Washington level to the park superintendents and supervisors, realized that employees needed to have their personal lives in some semblance of order before they could return to being productive employees. The superintendents extended this liberal leave policy on a case-by-case determination based on written requests from employees beginning the third week after the catastrophe.

A system was set up for those employees who would be faced with losing accumulated use-or-lose annual leave because of the hours they had devoted to the hurricane recovery efforts. These employees could apply for exemptions to protect their leave.

Relocation Consideration. Personal hardships, such as the emergency transfer of an employee whose spouse was stationed at the destroyed Homestead Air Force Base, complete loss of a home and personal possessions, or unrelieved mental stress related to the storm, caused several employees to request relocation assistance to other parks. Superintendents distributed information and forms to employees at the all-employee meetings.

Legal Services. Free legal services relating to real estate, assistance from the Federal Emergency Management Agency, tort claims, construction contracts, insurance, and landlord-tenant issues were offered to employees at several meetings.

Uniforms. The National Park Service made arrangements with R & R Uniforms, Inc., to quickly ship replacement uniforms to the south Florida park employees; the National Park Service established a special $400 uniform replacement allowance.

Emergency Medical Program

In the heavily populated areas surrounding the south Florida national parks, the hurricane could have potentially caused a large number of injuries and fatalities. The death toll immediately following Hurricane Andrew was moderately light for a disaster of this magnitude, with 46 reported fatalities in south Florida. Significantly, one of the fatalities included a beloved and respected Fort Jefferson seasonal employee, Natividad "Tito" Rohena. Rohena was killed in his home in Homestead. His adult son was seriously injured from the same falling debris.

After Biscayne rangers had warned all boaters to evacuate the islands, a vessel with three adult males moored out near Adams Key. Family members reported the overdue vessel to the U.S. Coast Guard after the storm. The three men had tried to ride out the storm in their boat. All three came on deck during the eye of the storm to secure the lines. One was killed from flying debris when the winds, now blowing from the opposite direction, resumed. Another was washed overboard. The third man tried to hold on to the body of the man that was killed from debris but eventually had to let go to prevent himself from being washed overboard. He rode out the storm in the bait well of the boat. The boat later broke free from its mooring and washed aground. The U.S. Coast Guard found the surviving man in the mangroves. On August 29, an NPS helicopter found one of the deceased victims in the Biscayne waters.



Employee injuries relating directly to the hurricane were limited to numerous minor traumatic accidents. However, an Everglades retiree, who had continued working in the park as a VIP, had a major heart attack while volunteering in a relief kitchen, 48 hours after the hurricane. He has since recovered.

Park medics established medical units in Big Cypress National Preserve, Biscayne National Park, and at Pine Island and Flamingo in Everglades National Park. Park medics are a specific certification level recognized only in the National Park Service. During the first four weeks of the incident, these medics treated over 300 employee and incident patients. Treatments were for a ruptured back disc sustained during roofing repairs, a fractured leg, chest pains, extremity injuries, hypertension, and numerous environmental problems due to heat, poisonous plants, and insects. Personnel arriving from outside south Florida, who were not acclimated, experienced respiratory problems.

The surrounding community hospitals handled a high medical caseload after the hurricane, and the Baptist Hospital in Miami gave the park medics an extraordinary amount of independent medical control for advanced life-support cases.

Two additional medical duties, unusual to the Hurricane Andrew incident, were obtaining prescription medications for displaced employees or incident personnel, and providing for both tetanus and hepatitis inoculations for personnel because of the extreme health risks present in the community. In the first month, the medics provided over 200 such inoculations.

Several outside agencies provided support to the medical units. These agencies included the Federal Emergency Management Agency (insulin, prescriptions), the National Guard (medical supplies), the Dade County Fire and Rescue (medivacs), and the Baptist Hospital (medical control).

By October 25, a total of 130 injuries involving 113 personnel assigned to the incident had occurred. One-third of the injuries were environmentally related (e.g., poison wood or poison ivy), and 55% of the injuries had no additional medical costs.

Housing

The Incident Management Team faced two challenges related to housing: finding housing for displaced park staff and their families and housing for incident personnel.

Once the magnitude of the hurricane damage became apparent, the need to provide shelter for displaced park employees and their families became a high priority. As a result of the hurricane, 101 employees and their families living in the parks and in communities near the parks lost their homes and most of their possessions.

Another 76 employees had homes that could be temporarily repaired. Providing food, water, and temporary roofing materials allowed some employees to remain in these homes.



For those whose homes had received severe damage, temporary shelter was provided at several locations, including the lodge at Flamingo and undamaged government housing, such as the motel complex that contains the headquarters of Big Cypress and vacant seasonal and permanent housing in Big Cypress. Trailers were not considered suitable housing even on a temporary basis.

The Incident Management Team contacted the NPS lands office in Naples to assist in obtaining rental houses for displaced park employees. The lands office sent a four-person group to locate rental property within commuting distance of Everglades and Biscayne. Suitable rentals were not available in the undamaged suburbs south of Miami. Intense competition for rentals existed in this area because of the large numbers of people that were displaced by Hurricane Andrew. A part of the team searched to the south of the damaged area and located suitable rentals in the Key Largo area. Impressive creativity and flexibility were used to obtain these rentals.

Finance officials and the realty team were able to satisfy real estate agents and landlords unfamiliar with government contracting procedures, while maintaining the integrity of the procurement process. Through the efforts of this team, 30 rental homes were provided.

During the first weeks after their arrival, the Type I Incident Management Team slept on wet floors (and a few sofas) in the headquarters at Everglades, which became the command post. Some found room in the hurricane-resistant dispatch wing, which had generator power and air-conditioning but had limited, and wet, floor space. Meals were primarily MREs. Lodging accommodations nearest the Everglades headquarters were at least a one-hour drive away and were filled with citizens who had lost their homes.

The Flamingo lodge had not been damaged but did not have utilities. This lodge became an obvious choice to investigate for temporary housing. Power was supplied with generators, but the power-dependent sewage treatment plant proved inoperable due to saltwater intrusion into the sludgebeds. Once the dead sludge was pumped out and replaced with active material, the plant was brought back on-line to serve the lodge and restaurant. The water treatment system was also brought back on-line, seawater infiltrated lines were flushed, and the system was tested for potability before Flamingo was used. TWRS employees were granted permission to stay in rental houseboats at Flamingo while working on repairing the utilities.

Within two weeks of the storm, the Incident Management Team provided a self-sustaining place in Flamingo to house 300+ displaced park employees and their families and incident personnel, including food service, laundry, and evening activities.

Power

No commercial power was available to Everglades or Biscayne immediately after the hurricane. Overhead lines were downed throughout south Dade County, including those leading to the parks.

The Incident Management Team realized that a significant increase in generator capacity would be needed; the limited generator capacity of the parks would not be sufficient to support the resources that were needed to manage the incident.



By early September, 200 small and 20 large generators were on the incident and capable of producing 2.2 megawatts of power. All critical facilities and power-dependent utility systems operated on generators from August 24 until commercial power was reconnected. This situation varied from September 21 at Everglades headquarters and Pine Island (when a temporary overhead line was installed) to early December for Flamingo when the new underground powerline was activated.

Powerline to Flamingo

Power and telephone services to Flamingo were provided through overhead lines that were destroyed during the hurricane. Rather than replace the aboveground lines, Everglades requested the assistance of the Incident Management Team to place the new lines underground; this request would meet the objective of providing underground power to Flamingo that was identified in the Everglades 1979 Master Plan.

The Incident Management Team brought in a Denver Service Center designer and a contracting officer who took on the project full-time. Since the powerline project could not be charged to the incident, a special construction account was established. With the assistance of the task force that conducted the facility assessments and the Florida Power and Light staff, the contract was completed in 108 working hours. The contract allowed the National Park Service to provide all the supplies and materials, and arrangements were made through Florida Power and Light to buy $1.2 million of the materials.

The Incident Management Team completed the National Environmental Protection Act and the National Historic Preservation Act compliance requirements.

Negotiations with a potential contractor from South Bend, Indiana, began on September 3, and field inspections, including subsurface testing, occurred September 4-6. A $6.5 million price was negotiated with the contractor on September 9, using the services of a Small Business Administration mediator. The Denver Service Center provided project supervision, and construction began September 25, with completion in less than 90 days.

Communications

The Type I team did not have reliable communications with the outside world. Telephone lines were generally down in Everglades and Biscayne. Cellular systems were not useable due to the volume of competing traffic. Radios worked, but the storm had misaligned the repeater antennas, decreasing the signal capability and quality. Prepackaged radio kits arrived with the Incident Management Team, greatly enhancing incident communications.

In the first three to four days after the hurricane, Big Cypress personnel at Oasis and personnel at Everglades City were critical in relaying messages and ordering supplies for the parks and the incident. Two telephone lines at Flamingo were discovered to be operable. They were connected to the Fort Myers exchange rather than Homestead, and they provided the team with a more direct line to the outside world to order supplies and resources. Incident personnel also secured telephone access at the Monroe County emergency operations center in Homestead.

The Type I team immediately began searching for a portable telephone system. Since all private vendors under contract to the interagency fire center had already committed their systems to relief efforts in the local communities, a nationwide search for alternate systems was made between August 25 and 28. A system was found and arrived on August 27, but this system proved to be nonfunctional. Even when working, the system had only one telephone line and had to be used outside.

AT&T was able to provide a KU band flyaway satellite system and technicians from their resources in California and Virginia. AT&T uses this system for emergencies and for use by the presidential press corps. The system and technicians arrived on August 29; a dial tone was operational at 2400 on August 30 and telephones were in use by 0700 on August 31.

The Hurricane Andrew incident was the first use of this type of satellite telephone system by a land managing agency and the first time that the Federal Telephone System and AT&T contract involved procuring such a system.

Since all aboveground telephone lines were down in the Everglades headquarters area, 8,000 feet of 25-pair telephone cable was ordered, delivered, and installed. Telephone cable was in great demand, and AT&T assisted in locating the necessary cable.

Logistics

The logistics section of the Incident Management Team encountered distinctive challenges. Basic systems were either destroyed, damaged, or inaccessible. Water, communications, supplies, food, and lodging systems had to be established or constructed. In the first few days, the logistics section had to address the continual breakdowns of the many temporary repairs. Personnel who normally operated these systems were generally not available. Consequently, many innovative applications of skills were developed to operate the initial relay communications system, generate electrical power, ensure potable water delivery, and provide supplies and materials for employee assistance teams, park staffs, and incident personnel.

Damage to most buildings in the parks and unrest in the communities meant that supplies and materials that were needed could not come the most direct route. Fort

Myers and the Oasis visitor center in Big Cypress became the route that was used to deliver supplies to the parks. Purchasing and payment teams were stationed at Oasis to expedite material acquisition.

Within a two-week period, the maintenance task force constructed a 120-foot by 24-foot storage building at Oasis for incoming materials.

The logistics section also ordered vehicles and equipment to support the maintenance task force and fire crews. Over 324 passenger vehicles and small trucks were used to support the incident. A total of 541 pieces of equipment were delivered to the project in the first four weeks of the incident.

The supply unit received requests for a wide variety of equipment items, including helicopters, front-end loaders, chippers, road brooms, a work boat, boat motors, bucket trucks, stump grinders, refrigerated trucks, 46 passenger buses, air compressors, underwater chain saws, plumbing tools, and computers.

Interim Hurricane Plan

Hurricane Andrew was the first tropical storm of the 1992 North Atlantic hurricane season. Concerns were expressed early in the incident that another hurricane could hit the area already made vulnerable from Hurricane Andrew.

Makeshift utilities, damaged structures, piles of building supplies and debris, and the already stressed status of park employees and incident personnel would make the passing of a second hurricane even more devastating.

An interim hurricane plan was prepared by September 27 to address this possibility. The plan was similar to the park hurricane plans. The interim plan presented specific actions for each of the four hurricane preparedness condition levels. The response times for conditions 2 and 3 were increased by 24 hours each to allow more time for securing and evacuating. The interim plan referenced individual park hurricane plans to provide specific actions to be taken for each condition in the largely unaffected areas of the parks, such as Flamingo, Everglades City, and Big Cypress National Preserve.

The interim plan contained several elements for each of the preparedness levels. Condition 4 included producing shutter materials for buildings that were damaged, developing equipment and food caches separate from those being used for the disaster relief, minimizing the storage of debris piles, identifying evacuation routes and transportation resources, and developing a rapid-response strike team to be positioned outside the path of the hurricane. The strike team would reenter the damaged area shortly after the passage of a hurricane to conduct emergency operations and assess resource needs.

Under condition 3, the interim plan provided for the rapid evacuation of people who had already experienced Hurricane Andrew. The plan provided deadlines for completing the preparedness procedures to provide ample time for evacuation.

Condition 2 of the plan provided instructions for evacuating all personnel. The exception to this total evacuation would be a voluntary security detail who would stay in hurricane shelters to provide status reports, damage assessments, and security for the evacuated facilities.

The plan specified posthurricane response procedures, including the roles of the voluntary security detail and the rapid-response strike team. The plan also included appendices for evacuation locations and travel routes (many of which would be by using small aircraft), a hurricane preparation "punch list," and recommendations for future hurricane planning.

Technical Specialist, Hurricane

The Incident Management Team brought the superintendent of Fort Sumter National Monument to south Florida as a technical specialist because he had experienced Hurricane Hugo. His long-term understanding of how things worked and how people reacted after a hurricane provided great insight to the Incident Management Team and led him to be designated deputy incident commander for contingency planning. Among his other major duties, he coordinated congressional and departmental inquiries, particularly those relating to damage assessment and budget for the three parks. He also worked on the donations to park employees from other NPS employees throughout the country, the powerline contract, temporary housing for park employees, and the facility and resource assessments.

Facility and Resource Assessment Task Forces

A facility assessment task force, consisting of engineers and architects from the Denver Service Center, assessed the damages to park facilities and developed cost estimates. The task force completed three separate reports—one for each park—by September 30. They listed the conditions found as a result of the hurricane, the repair or replacement requirements, and the cost and time needed to complete the work.

A task force of 23 scientists and technical specialists, from archeologists to marine biologists, were drawn from many agencies, universities, and private firms, and from the National Park Service, to assess the effects of the hurricane on the natural and cultural resources of the three parks.

These scientists assessed resources from September 15-25 to determine the effects of the hurricane on coral reefs, seagrassbeds, hardwood hammocks, mangrove forests,

sawgrass marshes, pine forests, historic shipwrecks, and archeological sites. They determined the status of populations and habitats of endangered species, such as panthers, crocodiles, and bald eagles, and more common species that characterize park ecosystems. They also examined the quality of air and water, and measured organic debris and sediments that shape biological communities.

Some members of the team served as consultants in the survey design and in the review of the report; others coordinated field teams in their general areas of expertise, while others compiled existing knowledge and conducted observations to complete the picture of resource conditions. Virtually all contributed to identifying the long-term needs to ensure healthy park resources.

Hazardous Material Removal

Several of the buildings in Biscayne and Everglades contained asbestos shingles or siding. The winds and storm surge of Hurricane Andrew damaged some of these buildings, creating asbestos debris. The Incident Management Team developed and awarded a contract to remove and properly dispose of this hazardous material and any other materials that the parks identified and stored.

The U.S. Coast Guard assisted in removing asbestos shingles and siding from Biscayne during early cleanup efforts.

Video and Other Documentation

Park employees identified the need for photo documentation while preparing for Hurricane Andrew. Some video footage of park facilities was recorded before the hurricane arrived.

The need for photo documentation became obvious in the wake of Andrew. For people who had not directly witnessed the destruction of the hurricane, the extent of damage was hard to comprehend without the aid of pictures. Early flights over the affected areas included videotaping the damages.

Systematic still photography began on midday of August 24. This project included photographing damaged structures and equipment, impacted vegetation, and employees at work in the recovery effort.

Coordinated video documentation of the incident began a few days later. A 13-minute videotape was produced in time for the visit of Director Ridenour on September 10.

A professional film crew was hired to make two video productions of the Hurricane Andrew experience in south Florida. The two videos run 27 and 13 minutes and include some of the footage that park employees had produced earlier.

Transition Plan

All incidents undergo a transition phase where formal return of delegation authority is made to the park superintendents. For most incidents, the transition is fairly simple. What made Hurricane Andrew unusual was that three parks delegated complete authority over all aspects of park operations to the Type I Incident Management Team. Perhaps more importantly, the physical and emotional effects of the hurricane were still widespread and prominent two months after the storm.

For a smooth transfer of operations back to the parks, one of the Type II team objectives was to identify and document functions and procedures that were needed to support the parks continued facility rehabilitation projects after October 26. To achieve this objective, a transition plan was prepared and approved on October 20.

This plan was a detailed blueprint that described the organization, function, and responsibilities of the personnel who remained to assist park staff, while also addressing such issues as radio communications, skills of remaining incident personnel, the incident resource tracking system, medical plan, and accounts.

As part of the planning process, the Type II team prepared three alternatives for the superintendents to consider: (1) demobilize the Type II team and incident personnel as soon as the task lists were accomplished and no later than October 25; (2) transfer incident responsibilities to the park by October 25, but provide continued administrative support during a transition period; (3) or maintain the current incident command situation until mid-December. On October 16, the superintendents selected the second alternative, and the detailed implementation transition plan was prepared.

The transition period of mid-October to mid-December was established to allow continuity in administrative functions and a smooth transition back to more routine park operations. A 20-person Bureau of Land Management administrative task force under the direction of the Type II logistics section chief was retained to work on Andrew-related matters for the Everglades administrative officer. They were primarily responsible for logistics, supply, demobilization, communications, resources status, situation status, documentation, and timekeeping.



Facility Assessments and Maintenance Activities

Hurricanes are not new to south Florida. Soon after Hurricane Donna blew through south Florida on September 10, 1960, the state of Florida commissioned a study to determine how buildings in south Florida should be constructed to withstand hurricane-force winds. The result of that study was the writing and the implementing of the south Florida building code. This code is recognized as one of the most restrictive in the United States and requires that structures be designed to resist a wind velocity of 120 mph, with adjustments for structure geometry and roof slopes.

Building codes, however, cannot provide all of the required design protection. Architects and engineers have substantiated that where heavy damage occurred, the south Florida building code was not followed. The poor judgment of builders is reflected in the lack of roof truss tie-downs, no protection of large glass areas, poorly constructed roofs, misuse of building materials, and poor workmanship, all of which contributed to the huge property losses from Hurricane Andrew.

Modular buildings and mobile homes were damaged the most. Materials for these buildings are of low quality, usually the lightest weight or thinnest available. Trailer parks throughout the area were decimated, leaving almost no recognizable structures standing.

The greatest damage to buildings was to roofs and their edges and screened-in exterior living spaces. Most other surfaces, including windows, withstood the winds and water until hit with flying debris. Interior damage to buildings occurred when water, having a high salt content and driven by the wind, breached the exterior building membranes. This damage is particularly serious in the south Florida climate.

Wet materials do not dry; they lose their insulating value and become covered with mold and mildew. These materials must be replaced, and full or partial demolition of a building may be warranted.



NPS facilities generally fared better than those in the communities. The National Park Service chooses, in most cases, to exceed the south Florida building code when constructing new facilities or remodeling existing buildings. In south Florida, NPS personnel from the divisions of maintenance are familiar with the potential threat of frequent storms and follow high quality construction practices. Despite an adherence to higher standards, Hurricane Andrew's winds far exceeded the building code standards, and damage was extensive to NPS facilities.

Soon after arrival, the Type I Incident Management Team requested that the Denver Service Center send a task force to assess the storm damage to facilities and to report cost estimates for repairing or replacing structures. This task force of architects and engineers started work on September 10 and completed their final reports on September 30, 1992.

Denver Service Center Facility Assessment Reports

Hurricane Andrew, Denver Service Center Facilities Assessment Team, Big Cypress National Preserve – September 30, 1992.

Hurricane Andrew, Denver Service Center Facilities Assessment Team, Biscayne National Park – September 30, 1992.

Hurricane Andrew, Denver Service Center Facilities Assessment Team, Everglades National Park – September 30, 1992.

Tables 2, 3, and 4 summarize the estimated costs for each park, by developed area. Class C estimates were used. These estimates are general, nationwide guides for approximating the cost of construction. Construction supervision, project inspection, and contingency costs were included in the estimates.

Project supervision and inspection costs are 15% of the estimate and the contingency held by the Washington Office is 16%. Design costs have also been added as a separate item.

Design costs were also included for those projects needing some planning before construction or repairs could be started.

For NPS facilities, where the cost of repairing damages was estimated to be more than for building a new facility, the building was recommended for demolition.

Although many structures survived the storm with only superficial or nonstructural damage, the structures may not be of hurricane-resistant construction. Severe damage should be expected to these structures if they are directly in the path of another hurricane.

Where the facility assessment task force observed that health and safety items did not meet the present building codes, those items were noted in the reports but were not cost estimated. These items could be addressed in future rehabilitation or construction projects not related to the hurricane.

Because some of the facilities at the three parks could be repaired quickly and because cleanup and disposal work was needed, a maintenance task force was assigned to each of the three incident operations branches to accomplish this work. They were made up of highly skilled NPS craftsmen, who generally came with their own tools and had the distinct advantage of knowing NPS construction standards and practices. Fire crews and interagency hotshot crews were used extensively in clearing and cleanup operations. Hundreds of downed trees had to be removed from roads, trails, and developed areas. These crews worked under difficult circumstances, with temperatures in the 90s and high humidity and poisonous plants, insects, and snakes.

TABLE 2. BIG CYPRESS NATIONAL PRESERVE DAMAGE ASSESSMENT		
Park Area	**Construction**	**Design**
Bass Lake Estates	$5,500	-0-
Birdon Road	$3,200	-0-
Everglades Shores	$30,900	$3,200
U.S. 41	$113,900	$4,700
Loop Road	$587,000	$120,200
Oasis	$273,300	$30,400
Ochopee	$12,500	$1,000
Turner River Road	$800	-0-
Subtotals	**$1,027,100**	**$159,500**
GRAND TOTAL	**$1,186,600**	

TABLE 3. BISCAYNE NATIONAL PARK DAMAGE ASSESSMENT		
Park Area	**Construction**	**Design**
Adams Key	$1,106,200	$197,300
Boca Chita Key	$5,163,800	$1,101,300
Convoy Point	$592,700	$129,600
Elliott Key	$4,236,000	$816,100
Navigable Waters	$153,200	$10,500
Subtotals	**$11,251,900**	**$2,254,800**
GRAND TOTAL	**$13,506,700**	

TABLE 4. EVERGLADES NATIONAL PARK DAMAGE ASSESSMENT		
Park Area	**Construction**	**Design**
Chekika	$2,356,600	$345,900
Environmental Education Center	$49,400	$7,100
Everglades City	$210,300	$2,200
Flamingo	$792,200	$102,300
Headquarters	$5,740,300	$1,262,100
Hidden Lake	$39,800	$6,000
Long Pine Key	$264,600	$43,000
Mahogany Hammock	$24,800	$5,700
Main Road	$260,700	$52,900
Pa-hay-okee	$133,900	$34,400
Pine Island	$2,720,200	$413,800
Daniel Beard Center	$1,009,200	$184,000
Royal Palm	$312,800	$47,200
Shark Valley	$452,600	$90,200
Tamiami Ranger Station	$207,400	$13,500
Trail Center	$308,000	$23,400
Subtotals	**$14,882,800**	**$2,633,700**
GRAND TOTAL	**$17,516,500**	

The maintenance task force performed hundreds of tasks throughout the recovery period. In some instances, contracts were established to accomplish specific tasks.

This section discusses the facility assessments and some of the repair and rehabilitation activities.

Buildings and Visitor Facilities

BIG CYPRESS NATIONAL PRESERVE

The facility assessment task force inspected 14 visitor use and support buildings throughout the preserve. Park buildings received most of the damage. Screen porches were blown away, and roof damage was widespread. Damage at Big Cypress, however, was relatively minor compared to Biscayne and Everglades.

The first priority for the maintenance task force was to close up and dry the roofs and remove or protect the contents that were damaged or wet. In Ochopee, the maintenance task force developed and issued contracts for screen-enclosures and roof repairs for the buildings. At the Loop Road facility, the chicken farm structure was demolished and cleaned up.

BISCAYNE NATIONAL PARK

Inspections at Biscayne involved 19 visitor use and support buildings throughout the park.



At Adams Key, park buildings received major damage. The casino club/visitor contact station, environmental education center, museum, laundry, generator building, and picnic shelter were seriously damaged from the storm winds.

At Boca Chita Key, serious damage was done to the park buildings. The maintenance building, seasonal quarters, comfort station, picnic shelter, and generator building were destroyed. The group shelter was heavily damaged. The chapel and lighthouse received minor damage.

At Elliott Key, damage was also heavy. The ranger station/visitor center sustained heavy damage but can be repaired. The comfort station, desalinization building, east maintenance area, and generator building received damage. The picnic shelter and oceanside shade shelters were destroyed.

At Convoy Point, wind and water heavily damaged the existing park headquarters. Most of the roof was blown off, and the remaining structure was not safe. The roofing was torn off the new maintenance and administrative buildings that were under construction.

At Elliott Key, the generator building was reroofed, and the roof was replaced at the maintenance facility. To provide basic visitor services again, the Incident Management Team ordered that modular buildings be replaced at Convoy Point. The modular buildings included a visitor contact station, administrative offices, ranger offices, a dormitory trailer, and public restrooms. The maintenance task force constructed decks, walkways, and steps for each of the modular buildings, along with providing and connecting the water, sewer, and electrical requirements. They also constructed a pole barn for boat repair and maintenance.



EVERGLADES NATIONAL PARK

The facility assessment task force assessed damage to 60 visitor use and support buildings throughout the park. The heaviest concentration of storm damage occurred at park headquarters, Pine Island, Royal Palm, the Daniel Beard center, and Chekika. Everglades had 11 large buildings with flat roofs; all were damaged from the high winds and left with wet insulation. The roof systems must be replaced. The mechanical and electrical systems in these buildings, in many cases, have served their useful life. The water damage from the storm necessitates that the mechanical systems be upgraded. Once rehabilitation takes place, current building codes must be met. Major renovation will be necessary in nearly all of the restoration projects.

Demolishing and rebuilding some buildings, such as the main visitor center, could be more cost-effective. Many of the other buildings have similar problems.

The maintenance task force cleaned up all buildings with roof and water damage. Wet carpets, ceiling tiles, and debris were removed and the offices and work areas cleaned. At the Daniel Beard center alone, 50 cubic yards of debris were removed, including two large freezers full of rotting research animals. The maintenance task force completed all roof repairs in Everglades City. At the Tamiami ranger station, they repaired and dried-in (temporary repairs to stop leaks) roofs and rehabilitated the interior of the building. A contract was issued for the emergency repair of the Iori warehouse roof system at the South Florida research center. At Shark Valley, the maintenance task force rebuilt the entrance station. They reroofed the public restrooms and demolished an apartment inside the Shark Valley tower. Temporary modular offices were brought in and set up for the park headquarters and the Daniel Beard center.

A modular visitor center was ordered for the winter visitor season. The maintenance task force repaired and dried-in the flat roof of the Daniel Beard center and other large structures with flat roofs.

Government-Owned Housing

BIG CYPRESS NATIONAL PRESERVE

The facility assessment task force conducted structural and condition assessments of 20 park housing units. Screen porches were blown away and roof shingles damaged. In Bass Lake Estates, 3 housing units required repairs. On Birdon Road, 1 house required repairs, and the adjacent storage building needed to be demolished. In Everglades Shores, 9 houses all needed repairs. On U.S. 41, the manor house required extensive repairs. In the Loop Road area, 3 housing units required repairs, and the pump storage shed was demolished. At Oasis, 1 trailer housing unit was demolished

and the other required repairs. On Turner River, 2 housing units required repairs. Damage to park housing, however, was relatively minor compared to Biscayne and Everglades.

Crews repaired and dried-in roofs, relocated contents of the houses, cleaned up screen porches blown off the houses, cleaned up the yards, and repaired windows. In the first five days, the maintenance task force performed emergency repairs to the roofs on five residences. An emergency repair contract was issued to perform repairs on two residential roofing systems. Much of the work on the Big Cypress housing was completed by October 24.

BISCAYNE NATIONAL PARK

All nine park houses received major storm damage. At Adams Key, one house was totally destroyed and the other received minor damage. At Boca Chita Key, two employee houses were destroyed. At Elliott Key, park trailers were destroyed, and both the east and west residences sustained heavy damage. The maintenance task force repaired the steps, screen porches, and electrical wiring, and reroofed park houses on Elliott Key. The Incident Management Team issued a contract for rehabilitating the Hudson house at Elliott Key.



EVERGLADES NATIONAL PARK

Fifty-two park houses were assessed. Damage ranged from major to untouched, with the heaviest damage in the Pine Island and Chekika areas. Most damage occurred to the roofing systems and windows. The facility assessment task force also inspected four concession houses and six wings of the Flamingo lodge. Damage to concession housing and the lodge at Flamingo was minor.

The maintenance task force dried-in all of the roof systems. At Everglades City, the roofs were repaired and dried-in. At trail center, the roofs of three modular houses were repaired and dried-in, and major interior renovations were completed. At the Tamiami ranger station, two house roofs were repaired and dried-in and interior repairs were completed.

Electrical Systems

BIG CYPRESS NATIONAL PRESERVE

The headquarters and Everglades Shores area had electrical power established the day after the hurricane. The Oasis visitor center complex was without electrical power for one week. The backup generator was old and undersized, and the low voltage burned out two motors in the automotive repair shop's air compressors. Two air-conditioning system compressors also had to be replaced due to low voltage from the generator. The Loop Road housing area was without electricity for two weeks.

BISCAYNE NATIONAL PARK

Overhead lines that provided commercial power to Convoy Point were downed by the storm. Generators supplied power to facilities on the islands. Electrical power was lost throughout the park. All overhead electrical lines, poles, and transformers were downed and generators damaged. All park operations, including water service on the islands, sewage pump stations and treatment plants, housing, visitor services, and phone systems, were inoperable.

A backup generator was on-site at Convoy Point within three days and powered the area until October 11. Commercial power was delayed because Florida Power and Light could not locate a suitable transformer, even after the electrical lines were restored. On Adams Key, the maintenance task force replaced the electrical lines on the docks, and at Elliott Key they made numerous utility repairs. They repaired generators and the switch panels on the Biscayne generators.

EVERGLADES NATIONAL PARK

Power was provided to and throughout the park from overhead lines, and all electrical power was lost when over 50 miles of overhead electrical lines and transformers were downed. All park operations, including water service, sewage treatment, housing, visitor services, and phone systems, were inoperable. Chekika also lost power. Electrical service to the park from Florida Power and Light was lost for over three weeks. The overhead electrical lines to Flamingo were over 50 years old, and were scheduled to be replaced in the future. Destroyed utility poles also downed the phone lines because they were attached to the electrical utility poles.

The electrical systems in the buildings and houses were nearing the end of their useful life. Significant water damage from the storm caused serious corrosion and failure in many of the electrical connections. Electrical codes have changed since the construction of the buildings and houses. Restoration will require that many components of the electrical systems be upgraded to meet the new national electric code requirements.

The Incident Management Team directed that electricity be restored as soon as possible. A backup generator was on-site at park headquarters and powered the park radio system, headquarters building, dispatch, and water system. Immediately, 20 main generators were ordered and placed at all developed areas in the park, and 200 smaller portable generators were acquired for outlying housing residents and employees who had lost power in the adjacent communities. The concessioner at Flamingo had 5 generators. The underground powerline to Flamingo is described in the Incident Management Challenges and Innovations section.

Water Systems

BIG CYPRESS NATIONAL PRESERVE

The metal shed housing the water treatment equipment at the Oasis visitor center was destroyed and the equipment damaged. The Ochopee community water system was not damaged, but the power was off-line long enough to allow the waterlines to be infiltrated by groundwater and be nonpotable. With the assistance of a Department of Environmental Regulation (DER) approved lab, which expedited water sample analyses, the water systems were back on-line and certified potable the afternoon of August 28.

BISCAYNE NATIONAL PARK

On the islands, the cistern collection systems were an integral part of the park buildings and house roofs. The storm blew away or damaged the roofs, gutters, and cistern, and the park was left without water. At Adams Key, the water collection system was destroyed. At Boca Chita Key, the solar-powered nonpotable water system was completely destroyed along with the cistern. At Elliott Key and Convoy Point, no damage occurred to the water systems.

The maintenance task force closed Boca Chita Key due to the extreme hazards and damage. The Adams Key water system was cleaned up and damaged lines were capped off to await future repairs.

EVERGLADES NATIONAL PARK

Everglades operates 17 water systems in three counties of south Florida. These systems received varying degrees of damage, but compared to other facility systems, they were well protected in buildings. The 20,000-gallon capacity Pine Island water system tank was full before the hurricane. Unfortunately, the high winds blew the solar panels off the roofs on the housing units in Pine Island, which caused the waterlines to siphon out all of the water in the tank. Once power was restored through portable generators, the well pumps were started and the tank was filled with nonpotable water.

Although no structural or mechanical damage was observed, groundwater infiltration in south Florida is severe. Whenever pressure is lost in the waterlines, the system must be chlorinated and stabilized. The system cannot be considered potable again until meeting all of the water quality analysis requirements at a DER-certified laboratory. All water systems lost power and were drained down, except for the headquarters system that was powered by the permanent backup generator. Once electrical power was reestablished with the generators, the water systems were tested and certified as potable.

Sewage Treatment Plants and Septic Systems

In Big Cypress a septic field failed at quarters 18, and a contract was issued to replace it so employees without housing could be moved into government quarters.

At Biscayne on Adams Key, the lift station flooded and the sewage pumps were damaged from storm debris. At Boca Chita Key, the septic tank, lift station, force main, and absorption field were destroyed. At Elliott Key and Convoy Point, no damage occurred to the sewer systems. On Adams Key, the maintenance task force rehabilitated the sewage lift station, and at Boca Chita Key they partially cleaned up the demolished sewage system.

At Everglades, no structural damage occurred to the Flamingo sewage treatment plant, but saltwater infiltration into the sewage lagoon killed all of the live sludge, leaving the plant without any treatment capabilities. The underground septic system at Shark Valley was also demolished when Florida Power and Light drove heavy equipment down the right-of-way to replace power poles. At Chekika the sewage treatment plant was off-line.

Contracts were issued to haul away the dead sludge at Flamingo. Testing for heavy metals and chlorides revealed high chloride levels as a result of saltwater intrusion, and the sludge was treated as hazardous waste. Trucking-in appropriate activated sludge was also required. Once the sludge was in place, the plant was activated and monitored and was functioning within the constraints of the DER requirements.

The Seabees reconstructed the Shark Valley drainfield. Suitable soils were delivered on-site, along with drainfield pipe and gravel. The park maintenance staff provided the plans and specifications to the Seabee unit, and the mound system was rebuilt and extended to handle higher volumes of effluent. Chekika remained off-line until final decisions were made for reconstruction.

Radio Systems

The radio system equipment at Big Cypress was not damaged, but tower guidewires were loose and the antennas had lost their alignment. The Incident Management Team issued a contract for tower maintenance. The towers were inspected and brackets repaired or replaced. The towers were grounded and guidewires were checked and tightened; antennas were realigned. Radios, equipment, and transmissions were checked for damage, function, and alignment.

At Convoy Point in Biscayne, the park's main antenna was completely destroyed. The base station, in a building without severe damage, was still functional but could not transmit or receive without an antenna. A new temporary antenna system was installed and the radio equipment moved to a modular building. Within one week, the park radio network was back on-line and provided the only means of communication with incident personnel at Everglades.

Similar to Big Cypress, the Everglades radio system equipment was not damaged, but tower guidewires were loose and the antennas had lost their alignment. The towers were inspected and guidewires checked and tightened. The antennas also were realigned. Towers were grounded and brackets replaced or repaired. Radios and equipment were checked for damage and function.

Telecommunications

The phone system at the Oasis visitor center in Big Cypress was off-line due to downed powerlines and phone lines on U.S. 41. The Incident Management Team made immediate contacts with the phone company, and the lines were restored two days after the storm.



At Biscayne, telephone services were lost during the storm. The Incident Management Team provided 2 cellular phones to the park almost immediately and ordered 14 more. As of October 24, the lines were not restored, and the park was still using a temporary microwave system.

Telephone lines coming into Everglades were run on Florida Power and Light power poles; the storm destroyed these poles. The Incident Management Team found and ordered an AT&T satellite phone system, commonly used by the presidential press corps. The system was mobilized and set up within four days of the storm. The system provided 24 phone lines, with 99 phones that were instrumental in coordinating all emergency operations. Crews laid over 1 mile of telephone cable to restore phone systems in the Pine Island and headquarters areas. A microwave shot was set up to provide telephone service to the Daniel Beard center, fire cache, and modular buildings on-site. A fiberoptics telephone line was installed as part of the contract to reconnect telephone and electrical power to Flamingo and the Daniel Beard center.

Roads

The 22-mile-long Loop Road at Big Cypress was heavily covered with downed trees, electrical lines, and storm debris and was closed due to hazardous conditions. The maintenance task force opened up a 7-mile section to access the Loop Road housing area. Trees and limbs were cleared from powerlines, allowing the electrical company to restore power to the area one week earlier than planned. The NPS crews worked on clearing downed trees on the remaining 15 miles of road for two and one-half weeks. The road was cleared and opened before hunting season.

At Biscayne, the Convoy Point access road, parking lot, and walkways were blocked by fallen trees and debris. Power poles and lines crossed the Convoy Point area and caused serious safety concerns. Vehicle access was impossible in most areas of Convoy Point until one lane could be opened. Newly laid asphalt on a parking lot was actually peeled off the surface of the ground by the wind. The maintenance task force cleared storm debris from all roads, parking lots, and walkways at Elliott Key. Parking lots, roads, and walks at Convoy Point were also cleared of debris and scattered building materials.

Fallen trees and storm debris blocked the road system in Everglades, parking lots, and walkways. Power poles and lines crossed all areas and caused serious safety concerns for the residents and employees in the park. Vehicle access was impossible in most areas until one lane could be opened, especially in the heavily vegetated areas.

The maintenance task force worked for the first six weeks after the storm to complete the major cleanup of debris and fallen trees. Priority was given to removing downed powerlines and utility poles and to opening park roads. Once these tasks were completed, roofs, walkways, parking lots, grounds, and housing areas were cleared. The Shark Valley road was opened October 13.

Campgrounds

Redbird and Blackbird primitive campgrounds in Big Cypress were closed due to downed trees and storm debris. No damage occurred to Fifty Mile Bend, Midway, Burns Lake, Dona Drive, or Bear Island campgrounds. A maintenance task force opened up the Redbird and Blackbird campgrounds. Numerous trees needed to be cut, chipped, and hauled away to allow the areas to be used during the upcoming hunting season.

On Boca Chita and Elliott Keys in Biscayne, the campgrounds were destroyed. All physical facilities were lost. On Elliott Key, the maintenance task force cleaned up the campground. The Incident Management Team issued a contract to clean up and haul debris from Boca Chita Key.

In Everglades, the Long Pine Key campground was severely damaged from high winds shearing off large trees. The access road was not passable, and the parking lot was completely covered with fallen debris. The public restrooms were damaged, but the building was still in place. The campsites were covered with debris, and much of the surrounding ground cover and low vegetation was crushed from the winds and fallen trees. The Flamingo campground received wind damage. Groundwater infiltration into the water and sewer lines was a problem because of the heavy rains and flooding.

The maintenance task force cleared all of the access roads, parking lots, and campsites. At Long Pine Key, the restroom was cleaned and determined to be usable, although it needed repairs. The maintenance task force removed hazardous trees and sawed up logs for campground firewood for the winter season. An interagency crew completed the cleanup of the campground on October 19. The campground was used to accommodate a construction camp and housing area for the Flamingo underground electrical contractors. Flamingo was cleaned up and the brush hauled off.

Boardwalks and Trails

The Kirby Storter boardwalk at Big Cypress was damaged from fallen cypress trees. The Snail Hammock trail on the Loop Road was also closed by storm debris. Both areas were closed to the public. The Snail Hammock trail was opened during the third week of cleanup. Trees were cut and moved off the trail, and a small footbridge was cleared.



At Convoy Point in Biscayne, 600 feet of boardwalk was lost or severely damaged. On Elliott Key, 1,600 feet of boardwalk along the Atlantic Coast was lost, and the Spite Highway trail was closed because of storm debris and downed trees. The maintenance task force conducted salvage and cleanup operations at Convoy Point, and opened and cleaned the north section of the Spite Highway trail on Elliott Key.

At Everglades, the Anhinga boardwalk and paved trail received storm damage from downed trees. This section was seriously damaged and unsafe. Mahogany Hammock boardwalk was damaged, along with the Pa-hay-okee boardwalk. Both boardwalks had sections destroyed and were unsafe. At Shark Valley, the Woodstork boardwalk was heavily damaged from the high winds.

The Pinelands, Gumbo Limbo, and Hidden Lake trails were closed because of debris and downed trees. All 30 miles of the fire roads were closed due to fallen trees and scattered debris. The Wilderness Waterway boat trail was closed from fallen trees.

The Anhinga boardwalk remained closed. The maintenance task force opened the Mahogany Hammock and the Pa-hay-okee boardwalks and the Gumbo Limbo, Pinelands, and Hidden Lake trails. They also cleared the Wilderness Waterway;

access by boat through the storm-damaged mangrove trees was a challenge for the work group.

Backcountry Facilities

At Big Cypress, two private hunting camps were destroyed in the Loop Road unit. No action was necessary. Owners of these structures were notified of the storm damage. At Everglades, rangers from the Gulf Coast district observed extensive damage to a number of sites in the northwest district immediately after the storm.

Trees and Landscaping Materials

The Loop Road housing complex in Big Cypress had severe tree damage. The large live oaks, the mature fruit trees, and the native trees were either broken or completely downed. Landscaping materials were also lost at Oasis and Everglades Shores. The maintenance task force traveled parkwide to saw up the downed and hazardous trees and hauled limbs to burn piles on-site. Fire crews burned the debris when weather and wind conditions permitted.



All developed areas in Biscayne received serious damage from the storm's high winds. A contract was issued for the massive cleanup of storm debris from Adams, Elliott, and Boca Chita Keys. The maintenance task force also helped clean up much of the developed areas on Elliott Key and Adams Key.

Landscaping in developed areas of Everglades received serious damage. Large trees were broken or pushed over, and smaller shrubs were crushed or pushed out of the ground. In the Pine Island housing area alone, over 400 trees were bucked, felled, limbed, and hauled to burn piles. Over 10 loads of trees were chipped into 80 cubic yards of mulch. The crews cleaned and raked the yards of residents. The crew also provided 12 loads of firewood for the park.

A native tree nursery was contracted to prune the trees that were salvageable in the developed areas. At the environmental education center, the maintenance task force cleaned up storm debris and straightened a chickee hut. Some trees that were pushed out of the ground were realigned and secured with guidewires. The impacts of heavy equipment that was used in the cleanup operations was evident. Turf was cut in the areas of heavy work. The impacts were unavoidable. The roads needed to be opened quickly for emergency operations access. A landfill site was designated for storage at the missile base until a hauling contract could be developed.

Signs and Navigational Aids

High winds downed and destroyed nearly all of the Big Cypress park visitor information, guide, and regulatory signs. No navigational aids were lost. The facility assessment task force inspected and developed a replacement order for 69 signs (costing $56,200). The park staff will install the signs once they arrive on-site. The maintenance task force cleaned up the damaged signs and posts.

Biscayne also lost park visitor information, guide, and regulatory signs. A high percentage of the park navigational aids was lost, including 17 channel markers, 48 anchors, 48 buoys, and cabling for markers, anchors, and buoys. At Stiltsville in the north end of the park, pilings from the house sites were washed out into the Safety Valve area, requiring clean-up. The facility assessment task force developed a replacement order for 91 signs (costing $31,100), and park staff will install the signs once they arrive on-site. The maintenance task force cleaned up the damaged signs and posts and replaced water hazard and navigational aids to open the park to boaters. Most of the work was completed by October 12. A contract was issued to the U.S. Coast Guard to replace the pilings and navigational aids at Caesar Creek.

Many of the visitor information, guide, and regulatory signs were lost at Everglades. The maintenance task force temporarily erected signs that could be salvaged to assist traffic on park roads. The destroyed signs were hauled away to disposal sites. On the Wilderness Waterway, 15 signs and 20 markers were missing. The facility assessment task force ordered 1,073 replacement signs, at a cost of $264,050.

Docks and Piers

No docks or piers were damaged at Big Cypress. At Biscayne, the main NPS boat harbor at Convoy Point lost all of its floating docks. Docks and piers at Adams Key, Boca Chita Key, and Elliott Key were lost or sustained serious damage. The maintenance task force repaired the docks at Adams Key.

Dams and Water Control Devices

At Big Cypress, all 31 water control earthen weirs were inspected and found to be in good shape. No action was necessary. At Everglades, the East Cape and Homestead canals on Cape Sable received major damage to the dams. At East Cape, the dam, constructed of earth, concrete, and large rock, had blown out. This structure protects the Everglades from saltwater intrusion into a man-made canal. The Homestead canal structure also was breached and needed repair. Fallen trees uprooted large sections of the earthen weir, breaching the structure at the Chekika dam. Future repairs are required.

Hazardous Materials

No damage occurred involving hazardous materials at Big Cypress, and no action was required.

Asbestos shingles, however, were found in some of the Biscayne roofing systems. Asbestos siding was blown off of the buildings, park houses, and private inholder houses. Much of the asbestos materials were blown into the waters surrounding the structures. A contract was developed to remove and properly dispose of the asbestos during the building renovation. This procurement also included surplus hazardous materials that were identified. The U.S. Coast Guard assisted in removing the asbestos shingles and siding from the islands.

At Everglades, asbestos panels and insulation are known to be in many of the older buildings. Radon was detected in the park headquarters. A hazardous removal and disposal contract, similar to Biscayne, will be developed. A contract will also be developed to remove and properly dispose of the asbestos that is removed during building renovation. A radon test will be conducted to determine if the air-conditioning system needs to be changed.



Park Files

No damage occurred to Big Cypress files, and no action was required.

The Biscayne park records were removed before the hurricane and museum collections were stored in the Daniel Beard center at Everglades. However, some of the Biscayne library books and research files were in buildings that were heavily damaged; the maintenance task force moved the park files and equipment to the Everglades missile base for storage. The curatorial records were taken to the Everglades regional collection center at the Daniel Beard center for drying and mold removal.

At Everglades, the Daniel Beard center roof was damaged, causing leaks in the area of the Everglades regional collection center. The lack of power and air-conditioning caused mold and mildew to start growing within a few days of the storm. Research files from offices in the Daniel Beard center suffered extensive damage. Records and files from the Everglades headquarters and the geographic information systems/fire cache were removed to the Daniel Beard center. The maintenance task force moved items from Everglades headquarters to the Everglades regional collection center for stabilization, drying, and treatment.

A modular building that was designed to house the curatorial collection was at the Daniel Beard center. This structure, which was promoted as providing an ideal, climate-controlled environment for museum collections, was designed to withstand 100 mph winds. Hurricane Andrew completely destroyed that facility. Although transfer of artifacts was scheduled to take place, none were transferred to this structure. A number of these structures are in place at parks that are vulnerable to hurricanes.

Vehicles and Equipment

The vehicle fleet at Big Cypress sustained three broken windows, and three vehicles had minor body damage, along with paint damage. The Incident Management Team issued a contract to repair the vehicles.

Two of the four GSA motorpool vehicles and park-owned vehicles at Biscayne were damaged from flying objects. Glass was broken, and dents and scratches in the paint were widespread. The park boats were not damaged because they had been evacuated to the Everglades missile base. The 45-foot work boat, which was moored at Elliott Key, was struck by flying debris from the visitor center. The bow was damaged, windows and hatches were broken and blown off, and water was taken in. Although still afloat, due to the age and condition of the vessel, this boat should be replaced. A 25-foot boat, stored and tied down at the missile base at Everglades, was damaged from flying objects.

A van that had been assigned to the deceased Fort Jefferson employee was crushed at the employee's home in Homestead. Another van rolled over at the Daniel Beard center in Everglades due to the high winds. Almost every vehicle had glass and paint damage, and most incurred small dents and scratches from flying debris.

The maintenance task force staffed the auto shop and made repairs as needed to a fleet of over 850 vehicles and pieces of equipment.

The Incident Management Team ordered that a contract be issued to replace window glass, repair body damage, and paint government-owned vehicles and boats in all three parks that were damaged from the storm.

Supplies and Materials

No damage occurred to the supplies and materials at Big Cypress. The Incident Management Team determined early on that a supply staging and distribution center was needed. The Oasis visitor center was determined to be an adequate facility. The maintenance task force constructed a 120-foot by 24-foot storage structure behind Oasis to handle the large shipments of building materials. This task was completed by October 8.

At Convoy Point, in Biscayne, the park lost all supplies, materials, boat parts, tools, and shop equipment that were at the headquarters and the maintenance facility. At Adams Key, the maintenance division's supplies and materials, tools, and equipment were also lost or damaged. At Elliott Key, the tools and equipment were intact except for the loss of janitorial supplies and materials. The Incident Management Team replaced supplies, materials, equipment, and tools.

The Iori warehouse in Everglades was severely damaged, causing water damage to the contents of the building. The warehouse was used to store building maintenance supplies and interpretive materials. The roof was repaired and dried-in. Supplies and materials were moved to areas in the structure that were still dry. Some materials were moved to a new location.

Resource Assessments



As soon as the storm passed, the National Park Service needed to know what had happened to the natural and cultural resources of the three parks. The first days of overflights revealed a dramatic scene, and the need to understand the magnitude of the effects became clear. Within days after the storm, the Incident Management Team formulated plans to mount an intensive effort to evaluate park resources. In early September, a professional resource assessment task force was assembled to measure ecological "vital signs." These 23 scientists and technical specialists ranged

from archeologists to marine biologists and were drawn from many agencies, universities, and private firms, in addition to the National Park Service. This section summarizes the findings of the task force; their complete report is available separately.

Other evaluation groups also looked at the fuels and fire management situation and assessed the damage to curatorial resources and documents. Remedial action was taken to stabilize documents and prevent further deterioration. Summaries of both findings are included in this section, and their reports are also available separately.

South Florida park ecosystems have evolved under a regime of hurricanes and other extreme environmental events such as fire and frost. However, chronic stress from fragmented habitats and altered water resources has probably reduced ecosystem resilience and the ability of populations to restore themselves after severe events like Hurricane Andrew. What effects the storm had on ecosystem structure and function were not possible to determine because the system was still responding, and insufficient information was available on normal system dynamics to evaluate current conditions. Short-term responses, however, appeared normal.

Vegetation

> Hurricane Andrew drastically affected a swath of vegetation about 30 miles wide across south Florida and the three parks. In hardwood forests, virtually every canopy or subcanopy tree sustained major damage. Pine stands in the hurricane's path lost 25-40% of the trees. Hurricane Andrew knocked down 70,000 acres of mangrove forests in the parks.

The influence of the hurricane stretched across significant portions of all three parks. The swath extended from Old Rhodes and Sands Keys in Biscayne across Long Pine Key and Shark Slough to the Ten Thousand Islands area of Everglades. U.S. 41 lay along Andrew's northern margin, yet significant effects were detectable even north of this landmark (for example, felling of red-cockaded woodpecker nesting trees). The northern edge of Cape Sable marked the southern boundary of the affected area.

The most dramatic, direct effect on natural resources was major damage to trees: broken trunks, broken branches, and wind-throw. Most damage occurred in hardwood hammocks, coastal mangrove forests, and pine forests on Long Pine Key in Everglades and the old-growth pine forest at Lostmans Pines in Big Cypress. Within the storm's path, virtually all large hammock trees lost their leaves, and 20-30% were wind-thrown or experienced broken trunks or loss of major branches. About a quarter of the royal palms were wind-thrown, and many others were defoliated but began resprouting within two weeks. Damage to trees and shrubs was most severe in or near the eye of the storm, where winds were strongest. Severity of damage decreased

rapidly away from the center of the storm track. Evidence of extreme wind gusts also decreased with distance from the central storm track.

In Everglades 25-40% of the pines were damaged by wind-throw or breakage. In Big Cypress, pines were the most impacted species, with 30% downed and 10% with broken trunks in the southern part of the preserve. Cypress trees fared much better than pines and hammock hardwoods. The cypress generally held their needles, but what appeared to be intense local gusts leveled a few domes.



The storm knocked down about 70,000 acres of mangrove forests in the parks. In contrast to the gradation of effects on upland trees, the boundary of effects in the mangrove forests was sharply defined. At Highland Beach, at the center of the storm track on the west coast, 85-90% of the mature mangroves were downed from the strong winds. Mortality in the mangrove forests will probably continue for a year or more. Many of the surviving trees have severely cracked trunks. Experience from other hurricanes suggests that many of these trees will eventually die as a result of the storm.

Some interesting comparisons can be made between the effects on south Florida plant communities from Hurricane Andrew, and the effects on similar plant communities from Hurricanes Hugo and Gilbert. The most dramatic difference in effects between Andrew and Hugo was in the high level of damage and mortality of pines in South Carolina and the relatively low level of damage in south Florida. By the end of the second growing season, 91% of the spruce pine had died, and loblolly pine showed high mortality also. Many of the South Carolina trees were well over 20 inches in diameter and 100 feet or more tall, as compared to less than 10 inches in diameter and 60 feet tall in south Florida. Since degree of impact generally appears to be directly related to size, the smaller trees in south Florida would have been expected to be relatively less vulnerable to hurricane winds. After Hurricane Gilbert, which crossed the Yucatan Peninsula in September 1988 (with 150 mph winds), only 16% of the downed trees and 29% of the broken trees died.

Understory plant communities were only moderately affected by the storm, other than damage from falling limbs and trunks. Many understory plants retained their leaves, and even fruits, formed before the storm.



Most rare and endemic plants in south Florida are found in the forest understory. Although immediate storm effects on these plants appeared minimal, long-term effects may be more substantial. Effects of reduced canopy and increased light penetration to the forest floor will change the competitive interactions between herbaceous endemics and hardwoods with unknown consequences. As a group, epiphytes probably suffered more mortality from the storm than any other plants due to their growth on tree branches and tree trunks, locations particularly susceptible to wind damage. A few of the epiphytes found in south Florida were only known from single sites in the parks. Some of these populations were possibly eliminated.

Fuels and Fire Management

Downed trees will increase the quantity of large fuels, changing fire prescription guidelines in some areas.

In the pinelands, broken and uprooted trees increased large fuels, an average of 36% on exposed sites and 31% on sheltered sites. In the Pine Island housing area, 40% of the pines blew down because the trees were larger and more exposed to the wind. Before the hurricane, almost no large downed trees were in areas sampled to determine fire danger. The moisture of the large downed trees (1000 hour or larger fuels) can now be measured and used in fire prescriptions.

The decaying leaves and branches that form the litter layer remain the primary carrier of fire in hardwood hammocks. Before the hurricane the moist, cool, shady conditions in the hammocks slowed drying of the litter and soil at the onset of the dry season. Soil moisture is still valid to use as a prescription limit to determine if and when soils and litter are dry enough to burn. However, soils and litter will dry more quickly because of greater penetration of sunlight and wind into the open forests. The relative humidity is also expected to be lower in areas where the canopy has been removed. Invasion of flammable plants, such as bracken fern, into canopy gaps and disturbed areas will carry fire when the soil and litter layers are too wet to burn. Dead and downed fuels will increase receptor sites for spot fires.

Despite the hurricane, Everglades parameters for fire prescriptions in the mangroves and prairies will not change. However, in the prescribed burning unit, the increase in large downed trees and heavy fuels in the pinelands will increase the duration of the prescribed burns, increase the amount and duration of smoke emissions, increase mop-up, decrease acres burned per day, increase cost per acre, and increase staff required. In the East Everglades fire management unit, blowdown of Australian pine *(Casuarina)* and melaleuca *(Melaleuca quinquenervia)* may modify fire prescription parameters in a similar manner.

Exotic Plants

The hurricane is likely to be an event that dramatically increases the numbers and distribution of exotic species. Melaleuca is south Florida's most invasive plant species, but Everglades has been kept largely free of it. The hurricane will probably disperse seeds to new areas, exacerbating the melaleuca problem. Brazilian pepper is the most serious exotic plant threat to native vegetation in Everglades, but Andrew is unlikely to increase its geometric rate of spread.

Nonnative plants have spread extensively in south Florida following hurricanes in the past. Hurricane Donna spread Australian pine up the west coast of Everglades in 1960, requiring an expensive eradication program in the 1970s. Brazilian pepper *(Schinus terebinthifolius)* was introduced to south Florida in 1898, but was not perceived as a problem until after the 1960 and 1965 hurricanes. Which species might explode as a result of canopy opening and nutrient release is difficult to predict.

Melaleuca is the most invasive plant species in south Florida as a whole and in Big Cypress in particular. Everglades has to date been kept largely free of melaleuca. The hurricane will probably exacerbate the melaleuca problem by dispersing seed capsules to new areas. Hurricane winds along the north edge of the eye would have tended to disperse melaleuca seeds from East Everglades toward Shark Slough. Seeds will likely be released in fall 1992 and germinate with falling water levels. If normal drought conditions prevail in the dry season, seedling survival will be low. A wet winter could result in a large crop of melaleuca seedlings. Less than 5% of melaleuca at Monroe and Paolita stations in Big Cypress were uprooted or broken off; these trees will resprout. Seed capsules left on the trees are not likely to open, but severed branches will undoubtedly release seeds.

Brazilian pepper is currently perceived as the most serious exotic plant threat to native vegetation in Everglades. At some sites, Brazilian pepper appeared to suffer as much hurricane damage as associated native species, so it is unlikely to gain a substantial advantage from the storm. These seeds are normally produced after the hurricane season (November-December), and hurricane damage to Brazilian pepper in the maximum zone of disturbance may preclude most seed production in 1992-93, although birds disperse seeds long distances (from other areas) in some years. *Schinus* does not have a long-lasting seed bank in the soil. Hurricane Andrew is highly unlikely to increase the current geometric rate of spread of Brazilian pepper.

The major area of Australian pine in Everglades was outside the main path of Hurricane Andrew. In East Everglades, many individuals were wind-thrown, but abundant resprouting will occur. Although storm surge from Andrew was much less than from Hurricane Donna, large-scale dispersal of Australian pine from the recent storm is a possibility, particularly on the islands of Biscayne.

Wildlife

Storm surge, extreme rainfall, and flooding are generally the major causes of wildlife mortality in hurricanes. The major impacts of this storm were caused from high winds, consequently Hurricane Andrew did not have major, immediately obvious effects on wildlife. Little direct mortality was observed. A summary of the effects of the hurricane on several wildlife species is provided in Table 5.

Air and Water Resources

In south Florida, Hurricane Andrew generated more than 40 million cubic yards of storm-generated debris (a football field stacked 5 miles high). Most of the debris was trees, shrubs, and building materials, but some was hazardous waste such as paint, solvents, insecticides, and batteries. Much of the woody debris was burned, which may adversely affect the air and water quality of the parks. The storm also destroyed or damaged much of the air and water monitoring equipment in the parks.

AIR RESOURCES

Most of the storm-generated debris in south Florida consisted of trees and shrubs (73%) and building materials (24%), but some included hazardous waste. In spite of the urgency to dispose of this material, the Florida Department of Environmental Regulation recognized in its emergency final order of August 26, 1992, that "the hurricane has . . . created a risk of further substantial impact on the environment," in addition to devastating direct storm impacts.

On September 21, 1992, the Dade County Department of Environmental Resources Management authorized 81 dump sites. The U.S. Army Corps of Engineers managed most of the dump sites near the parks and prepared an environmental assessment describing their plans. The resource assessment task force and Everglades staff reviewed these plans.

The task force found and mapped the locations of all county-approved debris burning sites, determined their contents, and evaluated the potential resource damage from their disposal. The task force then worked with appropriate regulatory agencies, compared potential impacts of incineration and other disposal methods, and recommended ways to monitor impacts and actions that would limit resource degradation.

On September 21, smoke from burning at nearby disposal sites was observed inside Everglades. Impacts along the eastern park boundary are of special concern because the main park interpretive corridor and entry to the park passes through this area. About 80% of Everglades 1,300,000 visitors enter the park on this road, and park

TABLE 5. EFFECTS OF HURRICANE ANDREW ON SELECTED WILDLIFE SPECIES	
Species (Federal Status)	**Effects of Hurricane Andrew**
Manatees	105 groups, totaling 209 individuals, were observed, representing the highest monthly count since a 1990 study. Manatees were observed in all aerial survey zones.
Alligators	Adult alligators appeared unaffected, but effects on nests and young were questionable. 1992 was a poor year for alligators before the storm. In a normal year, 25% egg mortality is experienced; this year, 43% died before the storm, and 27% were in nests destroyed by the storm. The fate of those in nests was unknown.
Crocodiles (endangered)	Mortality was unlikely unless they were directly in the storm path. Storm displacement has been hypothesized to be the cause of wandering crocodiles in the west coast river system. Approximately 3-4 days after Hurricane Andrew, two adults were observed in the mouth of the Shark River, traveling upstream.
Loggerhead Turtles (endangered	Nesting habitat may have been improved at several locations. In Biscayne, large numbers of jellyfish (an important food source) were seen in the offshore reef area. This year, approximately 50-60% of nests hatching after August 24 will fail due to compacted overburden, erosion, overwash, or redeposition.
Florida Panther (endangered)	Observation of habitat and movement indicates that Hurricane Andrew probably had no negative impact on the monitored panthers.
White-tailed Deer	Populations appeared unharmed. The hurricane caused individual deer to migrate to new areas and some of their feeding areas were damaged. The task force observed no evidence of deer overbrowsing. Public access to the southern portion of Big Cypress was closed.
Key Largo Woodrat and Key Largo Cotton Mouse (endangered)	They exist south of the main force of the storm (Key Largo) and were probably not affected.
Florida Black Bear	26 radio-collared animals were being studied before the hurricane. 25 were outside the area of major effects, and all survived.
Red-cockaded Woodpecker (endangered)	90% of known nest trees were downed. During 17 hours spent in active colonies, only one red-cockaded woodpecker was seen. Taped calls failed to elicit a response from his mate. In three active colonies, 12% of known nest trees were intact, and no active nest trees remained standing.
Wading Birds	200 wading birds at Biscayne were observed dead. Of 160 rookeries in south Florida, 16 were in the storm path. Resident white ibis and egrets seemed unaffected.
Cape Sable Sparrow (endangered)	Subspecies could have been favored by removal of litter from its habitat, although physical damage to a small population is also likely. Two populations were potentially affected, but one was outside the major storm path.
Southern Hairy Woodpecker	An increase might occur if this bird can forage on insects associated with wind-broken pines. However, the hurricane could have been strong enough to extirpate the small population.
Southern Bald Eagle (endangered)	Three nests in Big Cypress were damaged or destroyed. The eagles themselves were probably not harmed, and have been observed near the nest sites.
Snail Kites (endangered)	Of 75 radio-tagged before Hurricane Andrew, at least 7 were in hurricane-influenced locations. All 7 survived and were in the same general location as before the storm.
South Florida Tree Snail	The hurricane may be the final blow to already depleted populations of certain subspecies. In the future, increased light may improve food supply. However, lack of cover will also leave the snails more susceptible to freezes, drought, and predation over the next few years. Severe fires could depress local populations.
Butterflies (4 endangered species)	Adults were much less common than normal during the damage surveys. Adults surviving the storm itself may have died before food resources became available.



headquarters, maintenance facilities, visitor centers, and park employee residences are located nearby. Several permitted, open-burning disposal sites were near the Everglades eastern boundary, including one site in the Frog Pond area adjacent to the park boundary north of the main entrance. Burning at these sites and possibly more distant sites, depending on weather conditions, posed a threat to the park's air quality (class I designation) and may potentially have adverse impacts on sensitive plants, water resources, visibility, and human health. Also, the transport of debris to these disposal sites by thousands of trucks daily added to the air pollution that may affect the park.

Before Hurricane Andrew, Everglades routinely monitored air quality and meteorology near the South Florida research center, about 7 miles west of the park main entrance. As a result of the storm, all the park monitoring equipment was damaged or destroyed, as was equipment in most of south Dade County. Until the monitoring equipment is replaced and reliable power provided, no analyses of emissions are possible.

WATER RESOURCES

While poor air quality was the most visible environmental concern relating to the open burning of hurricane-generated debris, deterioration of water resources may also occur. Contaminants from debris burning pits and temporary disposal sites may reach groundwater and surface water via surface runoff, leaching, and atmospheric deposition.

From the standpoint of groundwater contamination, the sites of greatest concern to the National Park Service were those within one-half mile of the canals that deliver water to Everglades. By September 14, four burn sites were within one-half mile of these canals. While the U.S. Army Corps of Engineers burn pit plan recommends a minimum 1-foot impervious layer beneath each pit, impervious bottom liners were not being constructed at the sites that were inspected. The Corps confirmed that the construction of an impervious base was not widely practiced initially, although they recommended this design feature, and were attempting to encourage it in future burn pit construction.

As materials were burned, the ash was moved from the pit by a front-end loader, and stored in open piles pending removal to a permanent disposal site. Disposal alternatives included agricultural land application, industrial utilization, and export to appropriate landfills. Initially, large quantities of ash would be stored on-site for an undetermined length of time, awaiting removal and disposal. At sites that were inspected, residual ash was being stored in open piles, subject to both wind dispersal and leaching into groundwater.

Black Creek and Goulds Canal are close to the south Dade landfill and the Miami-Dade Water and Sewer Authority, south Dade regional wastewater treatment facility. This situation has created a long-standing, unresolved chronic water quality degradation issue. The storm may have temporarily increased landfill and possibly wastewater leaching into the canals. The hurricane did not appear to initially degrade water quality in the Princeton and Mowry canals anymore than normal storm water runoff after a major event. All four canals discharge into Biscayne Bay, and the effects of canal discharge on bay environments is not known.

Marine Ecology

Marine environments fared well in comparison to terrestrial systems. The major effect seemed to be increased turbidity that persisted for 30 days after the storm. Some patchy bottom scouring occurred, but generally submerged areas appeared to be intact compared to adjacent uplands. A few reeftops were scoured, but distribution of the effects was patchy and reefs naturally grow by breaking up and regrowing after storms. Sponges in Biscayne Bay were heavily impacted; 50% was gone from fixed plots, and others were killed by high turbidity.

The major storm effects on the marine environment were changes in nearshore water quality, patches of intense bottom scouring, and beach overwash. Dramatically increased turbidity persisted in some areas at least 30 days after the storm, particularly in western Biscayne Bay where mangrove peat soils continued to break down and enter the water column. In n ortheastern Florida Bay, at the southern edge of the affected area, dissolved phosphate, ammonium, and organic carbon all increased

dramatically. Plankton blooms added to increased turbidity and combined with observed low oxygen levels could have severe, long-term effects on fish and invertebrate populations.

Fuel from hundreds of damaged boats in Biscayne Bay and adjacent marinas continued to discharge into the water at least 27 days after the storm. A 500,000-gallon oil storage tank at the Florida Power and Light, Turkey Point power plant (near Convoy Point) was punctured during the hurricane. About 105,000 gallons of oil spilled, primarily into the retention berm around the tank, but an unknown quantity leaked into the cooling canals in the combined nuclear and oil-fired plant. Containment and oil recovery devices were in place by August 26.

Hardbottom communities in central Biscayne Bay were heavily scoured in some areas. Sponges and corals were sheared from the substrate, and found lying among expansive windrows of storm-generated vegetation and other material. Half of the sponges were missing from fixed plots sampled before and after the storm, and some remaining individuals were killed by sedimentation. In other areas, more than 90% of the larger seawhips and sponges were missing, but smaller individuals survived. Most of the juvenile spiny lobsters that resided under the sponges and corals in central Biscayne Bay were not present after the storm. Their fate may not be known for several years. In eastern Biscayne Bay, within one-half mile of Elliott Key, and in southeastern Florida Bay, benthic communities appeared relatively unaffected: lobster, sponge, and coral abundance were virtually the same before and after the storm.

Cape Sable and other west coast beaches had overwashes of 4-15 feet, with as much as 4 feet of deposition in a new beach ridge. Beach modifications associated with this storm were minor when compared to slower moving historical Florida storms. The storm's rapid forward speed appears to have severely limited the normal period of prolonged wave attack that a coastline receives before storm landfall. The intense winds of the storm moved into the Straits of Florida less than 2 hours before landfall on the eastern shores.

Disturbance to coral reefs was patchy but locally severe. A few reeftops were scoured, 200-year-old corals were rolled over, and branching corals were broken. Loose sponges of unknown origin accumulated at the bases of deep reefs. The levels of disturbance observed, however, were consistent with normal reef physical and biological processes. The most severe reef damage was associated with human debris. Lobster and crab traps smashed into corals and sponges. The Kavorkian shipwreck was a 75-foot coastal fishing vessel that was sunk seaward of the Biscayne boundary as an artificial reef. NPS personnel had evaluated the site approximately one week before the storm. The poststorm evaluation cònfirmed reports that the vessel was

completely destroyed and thrown against the nearby natural reef located in the park boundary.

Seagrassbeds in the storm track survived remarkably intact. Propeller cuts in grassbeds did not widen. Only a few areas south of Key Biscayne showed evidence of storm surge or wave action, with scour patterns cut 2 to 4 feet into the seagrassbed surface. These effects are in marked contrast with those of Hurricane Betsy in 1965 and other storms that have caused extensive destruction to seagrassbeds. Longer-term damage may be more extensive. Florida Bay is suffering continued expansion of the seagrass die-off, especially in the west. Turbulence from the storm continued to keep sediment in suspension, shading the seagrasses. This increased shade came at the time when light levels were declining naturally and may exacerbate the die-off.

In Biscayne, fish populations appeared to be healthy in all locations that were investigated. Everglades received numerous reports that sportfishing was excellent along the park's west coast after the storm. Fishermen out of Everglades City and those coming up from the Keys reported good catches of snook, redfish, seatrout, and tarpon. Fishes in the mangrove zone also appeared relatively unaffected, as evidenced by the presence of tagged fish in virtually the same places they were before the storm.

Freshwater Resources

> Hurricane Andrew was a relatively dry storm, and poststorm runoff reflected this. Water quality and freshwater fish appeared normal. Much of the monitoring equipment in the storm path was damaged or destroyed.

Hurricane Andrew was a fast-moving storm, with relatively little rainfall over south Florida. Surface and groundwater levels in Everglades responded as expected to the increase in rainfall and water management system's gate operations immediately after the storm. During the storm, large fluctuations in water levels took place at most stations in the affected area. The extended record indicates that these pulses were generally of the same order of magnitude as a normal increase in water level due to rainfall and gate operations.

Prestorm overland discharges of freshwater were normal for the summer wet season, and water levels were slightly higher than normal. Storm winds affected water levels, especially in Taylor Slough, where it rose over a foot briefly during the passage of the storm. The gradual rise observed in northwestern Shark River Slough over the weeks following the storm reflected high discharges through water control structures following abnormally high rainfall in water management zones to the north. Suspension of flows into the northeast Shark Slough and loss of the two pump stations that deliver water to Taylor Slough combined to reduce wetland water levels, hastened drying of marshes, and reduced freshwater flow into northeastern Florida

Bay. If the south Dade water delivery system was not restored quickly, marshes in eastern Everglades would dry, persistent dry season flows would cease, and critically high Florida Bay salinities would increase even more. Paradoxically, Hurricane Andrew initially worsened the drought-like conditions in northeastern Florida Bay, rather than relieving it by flushing the bay with freshwater.

Freshwater fish and macroinvertebrate populations seemed relatively unaffected by the storm, but historical information allowed detection of only 10-fold changes in populations. Strong seasonal and annual cycles in fish populations make short-term changes difficult to assess, even with optimal sampling schemes. The dynamics of these aquatic populations also vary with the seasons. In some areas, fish abundance declined, apparently related to the loss of periphyton cover (such as algae that live attached to underwater surfaces). At two central Shark River Slough sites, fish abundance dropped an order of magnitude after the storm and relative to normal seasonal levels. High variability in the spotty historical record makes it difficult to be certain that the observed declines were caused from the storm.

Within the constraints of limited samples, the storm appeared to have minimal effect on water quality in Everglades. Nearly all poststorm water quality information was within the range of values recorded from 1986 to July 1992. However, temperatures at two central Shark River Slough stations briefly increased 4 days after the storm, perhaps related to loss of periphyton cover. Short-term water quality effects were possibly missed in samples taken 4 days and 24 days after the storm.



The most significant impact regarding freshwater resources was the destruction of the hydrological and meteorological monitoring networks. Within the storm track, 80% of the monitoring stations sustained significant damage, virtually all of the gauges will have to be resurveyed to ensure an accurate reference to sea level.

Cultural Resources

> Damage to upland archeological sites appeared to be relatively light. Damage to submerged cultural resources was also much less than expected, although some submerged vessels showed erosion. Some curatorial resources and park files were damaged or destroyed, especially from high temperatures and humidity in buildings that did not have air-conditioning after the storm.

Marine archeologists resurveyed 14 of the 40 known wrecks in the parks and searched for newly uncovered sites. Overall, damage to submerged cultural resources was much less in all environments than expected, although some vessels showed signs of erosion. The Fowey and Safety Valve sites in Biscayne showed the most damage. Safety Valve barge was the most shallow site, exposed to the most surge which broke up the structure. All impacted sites except the Safety Valve barge exhibited signs of vandalism before the storm that contributed directly to storm impact. Looting had occurred on sites documented in 1992, with significant losses on at least one 1733 vintage site. Storm scour moved sediment off of at least two vessels revealing new artifacts, including a cannon and a wooden cannon truck from an early 18th century man-of-war. This hurricane did not jumble shipwrecks.

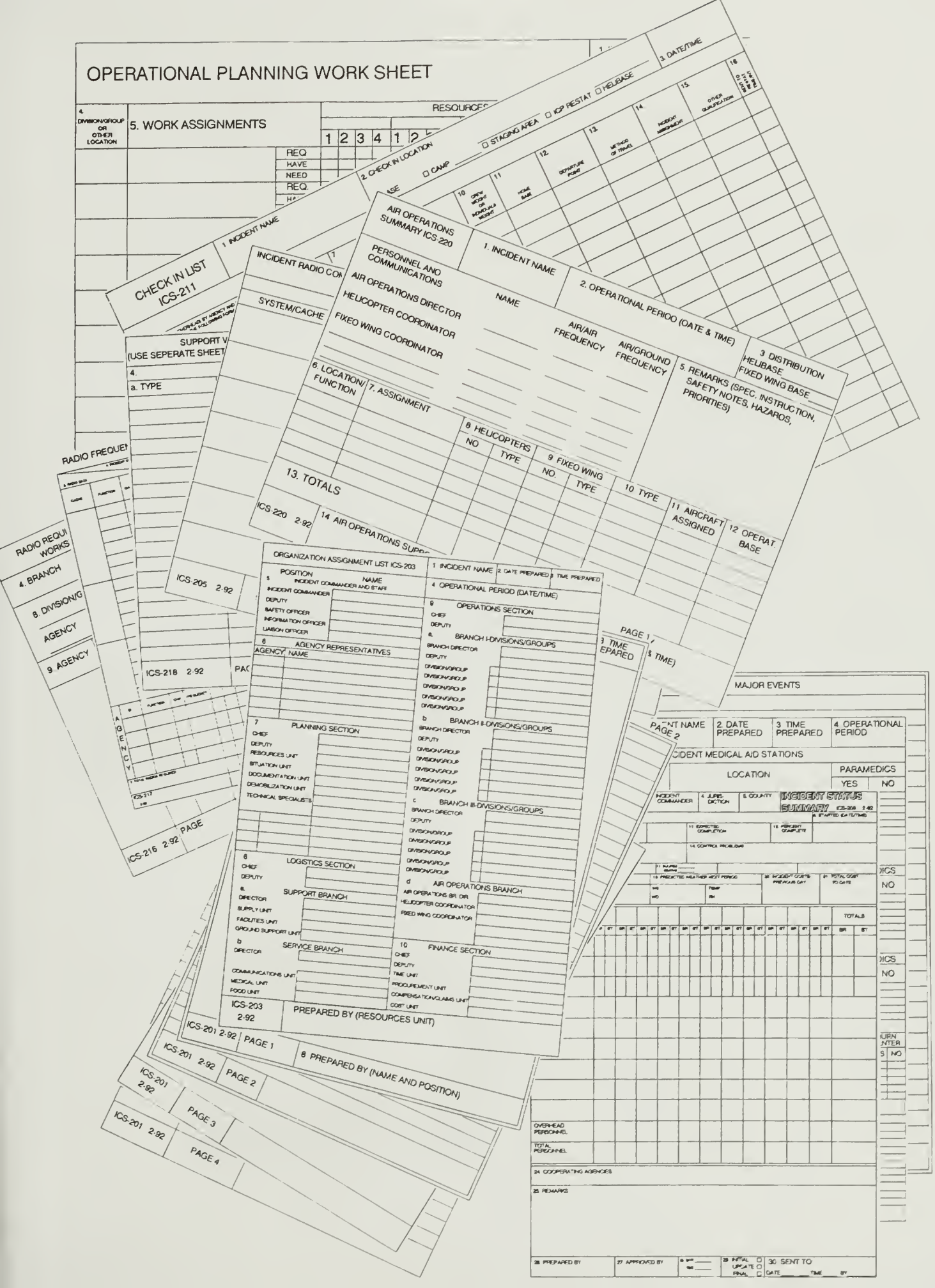
Archeologists assessed a representative sample of 22 of the more than 500 known upland sites in the three parks. Disturbance to upland archeological sites was generally minor. About 75% of the interior hammocks assessed contained wind-thrown trees that exposed or altered about 5% of each site. Sites along the Gulf Coast were similarly affected, with about 80% of the sites containing wind-thrown trees that disturbed 10% of each site. Storm surge deposited about a foot of shell and sand on about a third of the Gulf Coast sites sampled, effectively covering any disturbance caused prior to the deposition.



Glossary

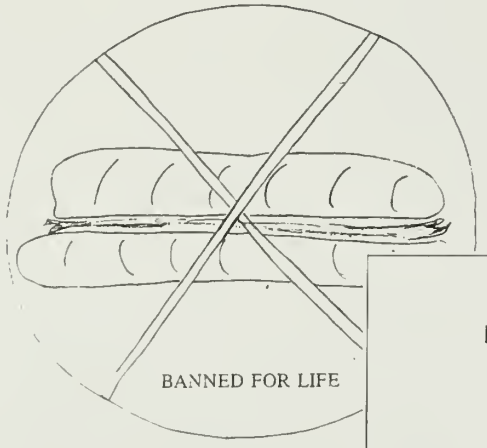
Branch	The organizational level having functional or geographical responsibility for major segments of the incident personnel. The branch level is organizationally between section and division or group.
Command Staff	The command staff consists of the safety officer, the liaison officer, and the information officer.
General Staff	That organizational level having functional responsibility for primary segments of the incident, which are the operations, planning, logistics, and finance sections.
Group	Groups are normally established to divide the incident into functional areas of operation. Groups are composed of resources assembled to perform a special function, not necessarily in a single geographical division.
Incident	An occurrence or event, either human-caused or natural phenomena such as Hurricane Andrew, that requires action by emergency service personnel to prevent or minimize loss of life or damage to property and resources.
Incident Command	The act of directing, ordering, and controlling resources by virtue of explicit legal, agency, or delegated authority.
Incident Commander	The individual responsible for managing all incident operations.
Incident Command System	The combination of facilities, equipment, personnel, procedures, and communications operating under an emergency operations organizational structure, with responsibility for management of assigned resources to effectively accomplish stated objectives pertaining to an incident. The organizational structure has position descriptions for each job. There is a chain of command, and everyone has a supervisor.
Incident Objectives	The Incident Command System is driven by objectives. The local agency administrator, the park superintendents in this case, and the incident commander determine the objectives. These objectives determine what tactical actions will be taken by the operations section, the workers who actually mitigate the incident.

National Interagency Incident Management System	This system collectively provides a total system approach to incident management. The subsystems are the Incident Command System, training, qualifications and certification, supporting technologies, and publications management.
Overhead Personnel	Personnel who are assigned to supervisory positions that include the incident commander, command and general staff, branch directors, division/group supervisors, and unit leaders.
Resources	All personnel and major items of equipment assigned to incident tasks on which status is maintained.
Strike Team	Specified combinations of the same kind and type of resources, with common communications and a leader.
Task Force	Any combination of resources with common communications and a leader organized to perform a specific task.
Technical Specialists	Personnel with special skills who are activated only when needed.


OPERATIONAL PLANNING WORK SHEET
5. WORK ASSIGNMENTS
CHECK IN LIST ICS-211
AIR OPERATIONS SUMMARY ICS-220
PERSONNEL AND COMMUNICATIONS
AIR OPERATIONS DIRECTOR
HELICOPTER COORDINATOR
FIXED WING COORDINATOR
1. INCIDENT NAME
2. OPERATIONAL PERIOD (DATE & TIME)
3 DISTRIBUTION
HELIBASE
FIXED WING BASE
5. REMARKS (SPEC. INSTRUCTION, SAFETY NOTES, HAZARDS, PRIORITIES)
6. LOCATION/ FUNCTION
7. ASSIGNMENT
8 HELICOPTERS
9 FIXED WING
10 TYPE
11 AIRCRAFT ASSIGNED
12 OPERAT. BASE
13. TOTALS
ICS-220 2-92
14 AIR OPERATIONS SUPER
ORGANIZATION ASSIGNMENT LIST ICS-203
POSITION
NAME
INCIDENT COMMANDER AND STAFF
INCIDENT COMMANDER
DEPUTY
SAFETY OFFICER
INFORMATION OFFICER
LIAISON OFFICER
AGENCY REPRESENTATIVES
AGENCY NAME
PLANNING SECTION
CHIEF
DEPUTY
RESOURCES UNIT
SITUATION UNIT
DOCUMENTATION UNIT
DEMOBILIZATION UNIT
TECHNICAL SPECIALISTS
LOGISTICS SECTION
SUPPORT BRANCH
DIRECTOR
SUPPLY UNIT
FACILITIES UNIT
GROUND SUPPORT UNIT
SERVICE BRANCH
COMMUNICATIONS UNIT
MEDICAL UNIT
FOOD UNIT
OPERATIONS SECTION
BRANCH I-DIVISIONS/GROUPS
BRANCH II-DIVISIONS/GROUPS
BRANCH III-DIVISIONS/GROUPS
AIR OPERATIONS BRANCH
AIR OPERATIONS BR. DIR.
HELICOPTER COORDINATOR
FIXED WING COORDINATOR
FINANCE SECTION
TIME UNIT
PROCUREMENT UNIT
COMPENSATION/CLAIMS UNIT
COST UNIT
ICS-203 2-92
PREPARED BY (RESOURCES UNIT)
8 PREPARED BY (NAME AND POSITION)
ICS-201 2-92 PAGE 1
ICS-201 2-92 PAGE 2
ICS-201 2-92 PAGE 3
ICS-201 2-92 PAGE 4
MAJOR EVENTS
2 DATE PREPARED
3 TIME PREPARED
4 OPERATIONAL PERIOD
MEDICAL AID STATIONS
LOCATION
PARAMEDICS
YES
NO
INCIDENT STATUS SUMMARY
TOTALS
OVERHEAD PERSONNEL
TOTAL PERSONNEL
24. COOPERATING AGENCIES
25. REMARKS
26. PREPARED BY
27. APPROVED BY
28. INITIAL
UPDATE
FINAL
30. SENT TO
DATE
TIME
BY

HURRICANE ANDREW INCIDENT

10/18/92

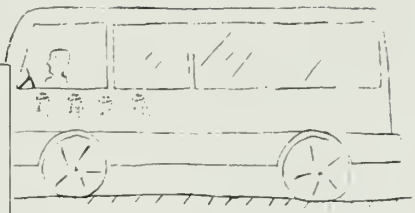


BANNED FOR LIFE

ANDREW INCIDENT

INCIDENT ACTION PLAN

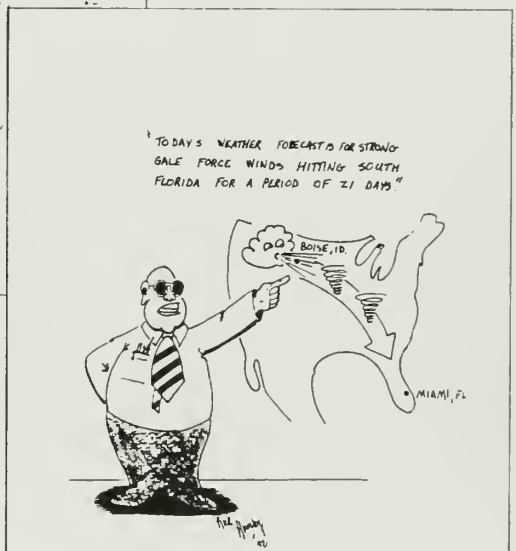
10/14/92



HURRICANE ANDREW INCIDENT

10/19/92



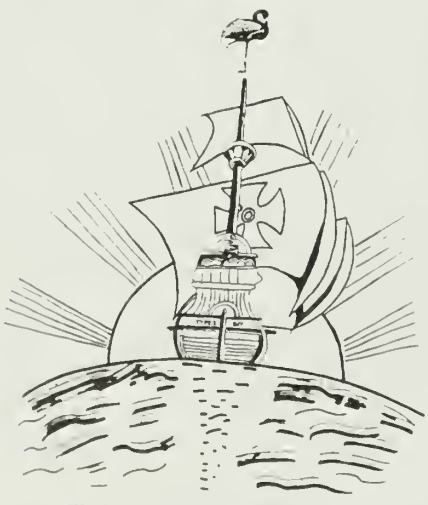


HURRICANE ANDREW INCIDENT

OCTOBER 22, 1992

How ICS Works...





THE ALL-RISK TYPE-2 TEAM SAILS INTO THE SUNSET

HURRICANE ANDREW INCIDENT

10/12/92

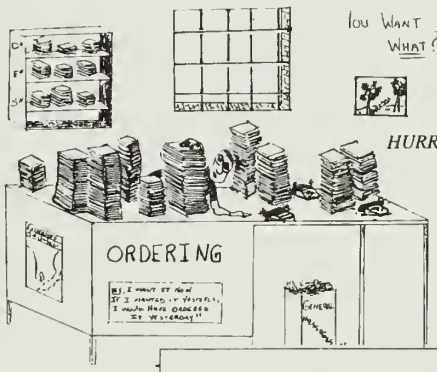


BARBECUE AT FLAMINGO

HAVE NO FEAR

DANIEL J. ("DAD") O'SULLIVAN'S HERE





HURRICANE

ANDREW

INCIDENT

10/10/92

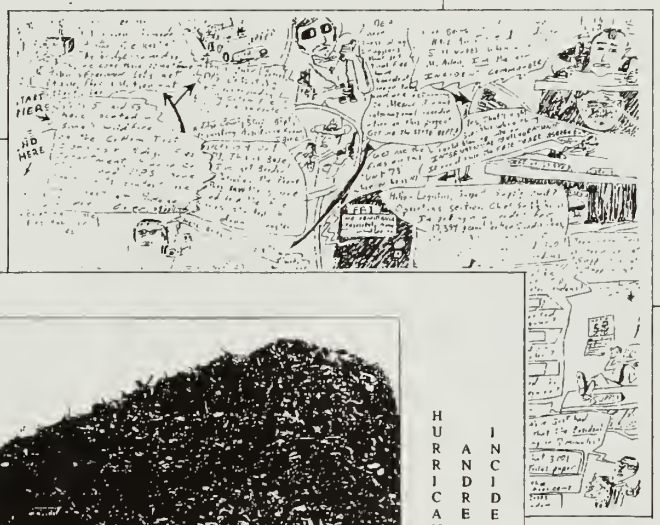
HURRICANE ANDREW INCIDENT

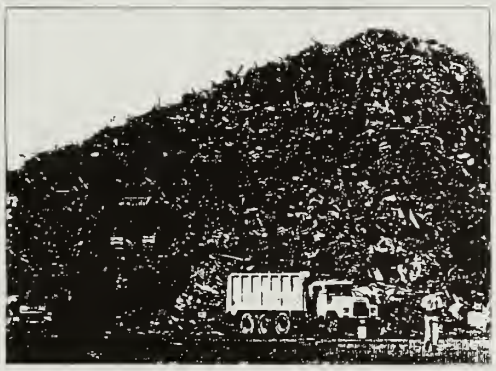
10/09/92



CONGRATULATIONS BRANCH I

POLE BARN CONSTRUCTED ON TIME AND UNDER BUDGET





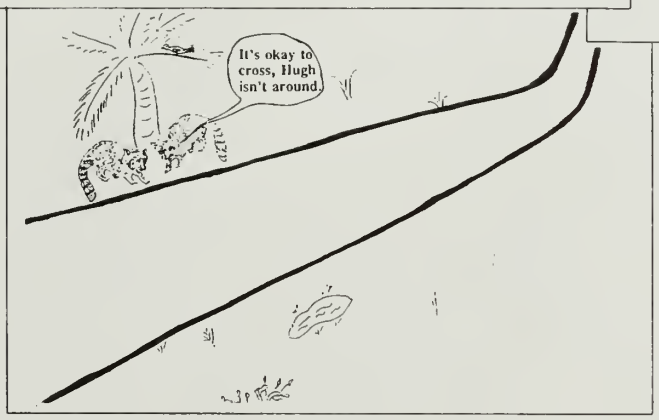
HURRICANE ANDREW INCIDENT

10/11/92

NOW TAKING APPLICATIONS FOR THE WINTER SKI SEASON AT "CLUB MIAMI"

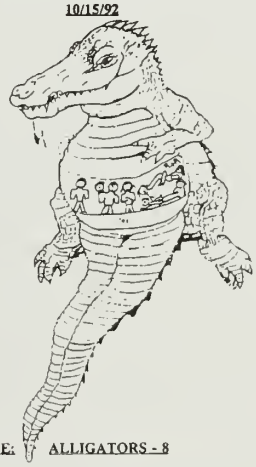


". . . BUT I THOUGHT IT WAS 55!"



HURRICANE ANDREW INCIDENT

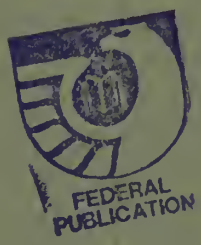
10/15/92



SCORE: ALLIGATORS - 8

INCIDENT - 4

Clemson University
3 1604 011 233 956



DATE DUE

APR 08 1996

Ret'd. APR 21 '96

DEMCO, INC. 38-2931





As the nation's principal conservation agency, the Department of the Interi
owned public lands and natural resources. This includes fostering sound us
our fish, wildlife, and biological diversity; preserving the environmental a
historical places; and providing for the enjoyment of life through outdoor r
and mineral resources and works to ensure that their development is in the
stewardship and citizen participation in their care. The department also h
reservation communities and for people who live in island territories under

Publication services were provided by the Branch of Publications and Grap
NPS D-183 August 1994

☆U.S. GOVERNMENT PRINTING OFFICE: 1995—841-286